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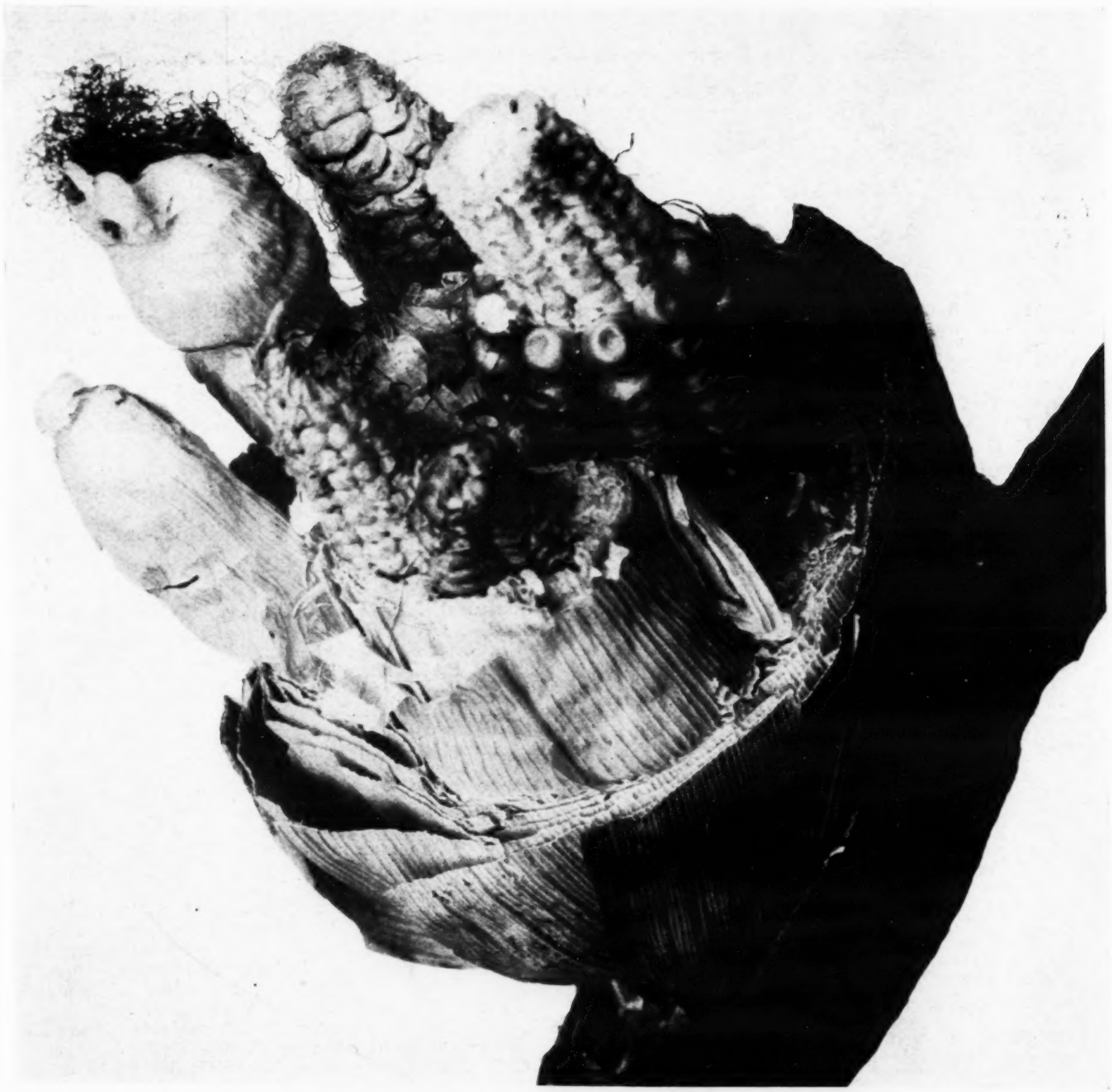

GATLING-GUN MAIZE

Twins Reared Apart

Leg-Feathering of Fowls

Whose Baby?

A New Peach

Wheat-Rye Hybrids

VOLUME 20 MARCH, 1929 NUMBER 3

The American Genetic Association

An incorporated organization devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks

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E. D. Metcalf

Sailor, Artisan, Justice of the Peace, Merchant, Stockman, Believer in Heredity.

Radiation Symposium

Papers by twelve of the pioneers in the new field of gene transmutation by means of X-rays and Radium. The results that are being attained promise to be of far-reaching importance.

Chromosomal Interchange

The Jimson Weed (Datura) yields new light on the origin of Geographic Races.

Twin and Triplet Birth Ratios

Peculiar numerical relations exist between the ratios of single births, twins and triplets. What is the biological explanation?

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TEMPERAMENTALLY ALIKE—MENTALLY DIFFERENT

Frontispiece

These girls are unquestionably identical twins. They have grown up in rather similar environments, but with quite considerable differences in formal education. The twin with the most schooling ("G" at right) rates highest in all tests of intelligence. The differences are much greater than those found in identical twins reared together.

MENTAL AND PHYSICAL TRAITS OF IDENTICAL TWINS REARED APART

Case II. Twins "E" and "G"

H. H. NEWMAN

University of Chicago

THE present report concerns itself with a twin pair of young women now twenty-seven years of age, separated when infants about eighteen months old, reared apart and entirely unknown to each other until their remarkable meeting about six years ago. For the last four years they have lived in the same city and have seen much of each other. They now have a very strong mutual affection.

They were born in a New York City hospital and after a short time were taken to an orphanage where they were kept until adopted, "E" at eighteen months and "G" at two years of age by two families living in different parts of Michigan.

When these twins were twenty-one years old, a Catholic sister from a convent in another city of the same state saw "E" in a bus and got into conversation with her, telling her that she was almost exactly like a girl who had been in the convent. Investigation showed that they were twins. A visit was soon arranged, and since then the twins have been in almost constant communication. This circumstance might seem to lessen the value of these twins for our purposes, for the years of association should go far toward wiping out any differences that have resulted from their nineteen years of complete separation. The differences to be described later are therefore all the more remarkable in view of the twins' recent close association.

Proof of Monozygotic Origin

"E" and "G" belong to that category of identical twins about which the experienced investigator of twins has no slightest doubt from the beginning. They are as strikingly alike as any pair of identical twins in our set of fifty pairs reared together. The accompanying photograph (Frontispiece) will serve to indicate their closeness of resemblance in spite of the fact that the faces are in quite different positions. The table on the next page gives their physical rsemblances and differences.

The greatest physical difference, and practically the only one of any consequence, between these twins, was the 1.1 inches difference in height. Such differences are common among identical twins reared together. The correspondences are so great and detailed that there cannot be any real doubt as to the monozygotic origin of these twins. In fact, it would be statistically nearly impossible to have this degree of identity in two individuals derived from separate zygotes. Moreover, none of the dizygotic twins in our collection even remotely approach the degree of resemblance exhibited between twins "E" and "G".

As a secondary check on the monozygotic origin, we have the following facts: that finger prints and palm prints are fully in accord with a monozygotic diagnosis. There is strong mirror-imaging in quantative values of finer patterns, the right hand of "E" and the left hand of "G" having exactly the same value, 34; the right hand of "G" has a value of 48, while the left hand of "E" has a value of 45. The striking same-sided asymmetry exhibited by the teeth and lips is in itself almost a sure sign of monozygotic origin. This pair of twins

Table I.

Physical Characteristics of "E" and "G"

	"E"	"G"
Height standing	58 inches.	59.1 inches
Height sitting.	31.4 inches.	31.9 inches.
Head Width	14.2 c.m.	14.1 c.m.
Head Length.	17.7 c.m.	17.75 c.m.
Hair Color	Dark brown, almost black, with scattering white hairs. Began to turn gray at 16 years of age.	Exactly the same.
Hair Form	Naturally wavy. Crown whorl clockwise.	Same Same
Iris Color	Light reddish brown	Same
Skin Color and Texture	Fair and clear, with little facial down.	Same
Ear Shape	Long, narrow and flat, of peculiar shape. Right and left ears alike.	Same
Handedness	Right-handed	Same
Features	Strikingly similar to "G". Left half lip fuller.	Same
Dentition	Lower teeth outside of upper when jaws closed. Middle line of tooth row considerably to the left. Tooth shape normal.	Same. in all respects.
Glove size.	$6\frac{1}{2}$	$6\frac{1}{2}$
Shoe size.	$4\frac{1}{2}$ B.	$4\frac{1}{2}$ B.
Voice	Soft and low.	Same.
Finger pattern formula		
Right hand.	1 2 3 4 5 U.U.U.U.U.	1 2 3 4 5 U.U.U.U.U.
Left hand.	A.W.U.U.U.	U.U.U.U.U.
Quantitative values of finger patterns.		
Right hand.	34	48
Left hand.	45	34
Total of both hands.	79	82
Palm print formula.		
Right hand.	11,9,7,3,:0,0,0,0,M	9,9,5",3:0,0,0,0, M
Left hand.	11,x,7,3 :0,0,0,0,M	11,x,7,3: 0,0,0,0,0

cannot be tested by comparing them with their sibs, for no relatives of any sort are known. This would be a serious detriment were the twins less strikingly identical physically.

Histories of the Twins

History of "E". At the age of one and one-half years "E" was adopted and was brought by foster parents to South Bend, Indiana. In the family were one foster brother and one foster sister, respectively nineteen and twenty-one years older than "E". Both married and left home when "E" was about eight years old. The foster father was a business man, owner of a small bottling works, and in fairly comfortable circumstances. The foster parents and their children had little education, the mother being unable to read and the father reading mainly the newspapers. "E" received no home instruction of any scholastic sort, but started to parochial school at six years of age. She finished the fifth grade when eleven years of age and after that had no more schooling of any sort. She had to stay home and help constantly with the house work because the foster mother was in poor health.

For several years "E" worked in a shirt factory, somewhat irregularly. At eighteen years of age she started to work in a dentist's office and has retained her position ever since. She considers that she is now very successful in life and has largely overcome the handicap of having had so little education.

History of "G". At the age of two years, "G" was adopted from the orphanage and taken by her foster-parents to Bay City, Michigan. The foster parents, rather young people, had no children of their own. The foster mother died when "G" was three and one-half years old, and the foster father was killed four and one-half years later when "G" was eight years old. The foster father was a railroad engineer and was not interested in education, but the foster mother wanted "G" educated and tried to teach her as much as she could.

At six years of age "G" went to kindergarten at the parochial school. She then skipped the first and second grades and went into third grade. After she finished the seventh grade she was sent to a Roman Catholic Academy in Detroit for one year to finish the eighth grade. She then took the full high school course at the same institution. Life in the Academy was restricted, the girls being kept within the precincts except on certain days when they went out in groups. "G" graduated in piano as well as in the general course, in four years. She then took a normal school course, lasting three years, involving training in methods of grade teaching. She then came to South Bend, where her twin sister was, and taught fourth grade for two years in parochial school, devoting two hours daily to piano. For the last two and one-half years "G" has been an assistant in a physician's office in South Bend and gives piano lessons in the evenings. She considers the work in the doctor's office extremely congenial and believes that she has now found her place in life. It is remarkable that the twins now occupy essentially the same sort of positions, one in a dentist's and the other in a doctor's office, and both consider their work almost ideal.

History of "E" and "G" compared. There is little difference between the social environments of "E" and "G". The foster parents in both cases were uneducated, or slightly educated, working people. The home environments offer no tangible contrasts. The striking difference in the two histories is, of course, in the amount of education received, "E" having nothing beyond the fifth grade, and "G" seven additional years, through normal school. There seems to have been very little significant difference between these twins in the matter of informal education, both having read little but news-

papers, magazines and fiction. They have had about the same sort of social contacts except that "G" associated almost exclusively with girls and women during her high school days.

It should be emphasized here that this pair of twins would be classed among those monozygotic twins in which the separation of embryonic primordia in twinning occurred very early and before the establishment of asymmetry between the right and left sides of the original single embryo. They are therefore derived not only from genetically equivalent primordia, but from materials still undifferentiated by the asymmetry mechanism. Therefore, whatever differences appear in their physical and mental make-up must be very largely attributable to the differences of environment or training, and since the environment in general seems to have been very similar for both, the differences in training must be the chief modifying factor. This is in contrast with the pair "A" and "O", described in the first paper of this series, where the education was practically the same, but the social environment was very different. Also there is a contrast with respect to the effects of the asymmetry mechanism in that the twins "A" and "O" must have seperated embryonically relatively late, for "A" is left-handed and shows other evidences of having been derived from the inferior side of the original embryo.

Mental Tests

These contrasts make the study of the mental and emotional differences of "E" and "G" of unusual interest. A brief summary of the results of various mental tests will tell the story. The following tests were given:

1. Stanford-Binet mental test.
2. Otis self- adminestering test of mental ability.
3. International intelligence test.
4. Stanford achievement test.
5. Otis group intelligence test.
6. Pressy X-O test of emotional and social attitudes.
7. Woodworth-Mathews emotional test.
8. Downey Will-Temperament test.
9. Kent-Rosanoff free association test.
10. Motor tests of various sorts.

The results of these tests will be summarized in the order given.

1. *Stanford-Binet mental test.* The results are tabulated below.*

The difference in mental age is twenty-three months, as compared with the average of fifty pairs of identical twins reared together, which is 8.4 months. Thus the difference in mental age between "E" and "G" is nearly three times the average of that of twins reared together. As might be expected, "G", the twin with the more extensive education, has the better mind. The difference in I. Q. between "E" and "G" is 12 points; while the average difference between fifty pairs of identical twins reared together is 5.3 points. Hence "E" and "G" differ in I. Q. nearly two and one-half times as much as the average of identical twins reared together.

2. *Otis self-administering test of mental ability.* The details of this and other tests will be published in a more technical form in another paper. Suffice it for our present purpose to give no more than the total scores with remarks upon outstanding differences in details. The total score of "E" is 11, that of "G" is 26. The intelligence quotients derived from these scores, using eighteen years as a base, are 69.0 for "E" and 84.0 for "G", a difference of 15, over three times the average of fifty pairs of identical twins reared together, which is 4.5. "G" excelled markedly in every item of the

*Results of Stanford-Binet Test

	"E"	"G"
Mental age	10 years, 6 mos.	12 years, 5 mos.
Intelligence quotient	65.6	77.6
Vocabulary	11,520	18,360
Interpreting lesson of fables	1 point	7 points
Memory for digits	year 9	year 12

test. "E" had 31 per cent of items correct, "G" 70 per cent.

3. *International intelligence test. (non-verbal).* The highest score possible in this test is 235. "E" had a score of 70, "G" a score of 98, about one-third more than "E". This test was not given to the identical twins reared together and hence no comparison is available. "G" excelled in every item of the test except in the mazes, where "E" scored one point higher. Since this test is believed to be a test largely, if not altogether, of native ability, the difference between "E" and "G" is quite striking and in agreement with those tests that are supposed to measure achievement as well as native ability.

4. *Stanford achievement test.* In this test, as might be expected, "G" was superior in every item and decidedly so in most of them. The educational age of "E" was shown to be ten years eleven months; "G" was distinctly more advanced, fourteen years one month. There is a difference in educational age of thirty-eight months, which is over six times as great as the average difference of fifty pairs of identical twins reared together (6.2 months). It is here that the effects of the difference in formal education stand out most sharply, and this is what is to be expected.

5. *Otis group intelligence test.* This test consists of ten categories—following directions, opposites, disarranged sentences, proverbs, arithmetic, geometric figures, analogies, similarities, narrative completion, and memory. In nine out of ten of these tests "G" was nearly twice as efficient as "E". In one, "disarranged sentences" "E" scored 15 and "G" 14, one point difference. Out of a possible score of 230, "E" made 62 and "G" 113 points. In terms of mental age "E" is nine years and ten months; "G" is fourteen years one month. This difference of fifty-one months in mental age is an extraordinary one, greater than one would be likely to find in sibs differing one or two years in age. In terms of the index of brightness, in which 100 is normal, "E" has a ranking of 32 and "G" a ranking of 83, over fifty per cent difference. As this test was not given to the group of identical twins reared together, no comparison can be made. It seems certain, however, that the difference between these twins is many times what it would be in the average of twins reared together. Of all the tests used this one seems to reflect most strikingly the effects of the great difference in educational experiences of these twins.

6. *Pressy X-O tests of emotional and social attitudes.*

*Test I. Things unpleasant.**

"G" has higher "affectivity", higher-toned emotionality, more fears, and especially more self-feeling. "E" has slightly stronger disgust reactions.

Test II. Words associated with given word.†

"G" makes more associations, probably because of greater vocabulary, and

***TEST I—Things Unpleasant**

	Median of 114 college students	"E"	"G"
Disgust		10	9
Fear		9	13
Sex		9	9
Self-feeling		7	15
Total Test I	41	32	46
Deviation	11	13	15

†TEST II—Words Associated with Given Word

	Total crossed out	Deviation from mode
"E"	28	10
"G"	47	7
Median for college students	55	10

they are somewhat more normal, possibly for the same reason.

*Test III. "Things you think are wrong."**

"G" has more reactions and they are slightly more normal, but the difference is not very significant.

Test IV.—"Worries — things dreaded."†

"G" has more worries than normal; "E" is about normal. Both have a much higher than normal score in connection with hyperchondriacal worries. Both have low scores in self-consciousness. "G" is distinctly more neurotic. In general, the resemblancs stand out more prominently than the differences. They are both low and high in the same places except in the one type of reactions just referred to, neurotic reactions, where the more highly educated twin has a much more abnormal score.

7. *Woodworth - Mathews test—unfavorable answers.*

	"E"	"G"
Fears	4	5
Dreams	2	1
Physical, Hurt feelings, Inferior feelings	5	8
Happiness, Worries, etc.	5	10
Making decisions	1	1
Feelings toward food		1
Imagination	1	
Total	18	26

The difference between "E" and "G" is 8 points, while the average difference between twins in fifty pairs of identical twins is 5.5. Hence the difference between "E" and "G" is only 2.5 points greater than the average. Out of seventy-five questions, fifty-five were answered similarly by both "E" and "G". For fifty pairs of identical twins reared together the average number of similar answers is fifty-eight. Again the emphasis must be placed upon the emotional or temperamental similarity of these twins rather than upon differences.

8. *Downey will-temperament test.* A study of the will-temperament profile (Table II) shows that "E" and "G" are not greatly different. Both would be rated by this test as rather weak personalities. There is little difference (less than three points) in Flexibility, Speed of Decision, Motor Impulsion, Motor Inhibition, Interest in Detail, and Coordination of Impulses. "G" rates higher in Speed of Movement, Freedom from Load, and Finality of Judgment. "E" rates higher in Reaction and Contradiction, Resistance to Opposition and Volitional Perseveration.

Analysis shows that "G" is more mobile or rapid-fire, and "E" more aggressive and forceful. The total score for "E" is 56, and that of "G" 59, which means great similarity, with minor differences. In temperament, "E" and "G" are remarkably similar.

***TEST III—"Things You Think Are Wrong"**

	"E"	"G"
1. Suspicious (paranoid)	9	12
2. Jumpy (neurotic)	5	14
3. Self-vonscious (shut in personality)	4	5
4. Melancholic	12	13
5. Hyperchondriacal	16	20
Total	46	64
Deviation of college students	46	46
Median of college students	46	46
Median deviation of college students	15	15

†TEST IV—"Worries—Things Dreaded"

	Total crossed out	Deviation from mode
"E"	53	15
"G"	75	12
College median	73	13

9. *Kent-Rosanoff Free Association Test.*

	1000 normal subjects	"E"	"G"
Common reactions.....	91.7%	79.0%	95%
Doubtful	1.5%	1.0%	0.0%
Individual	6.8%	20.0%	5%

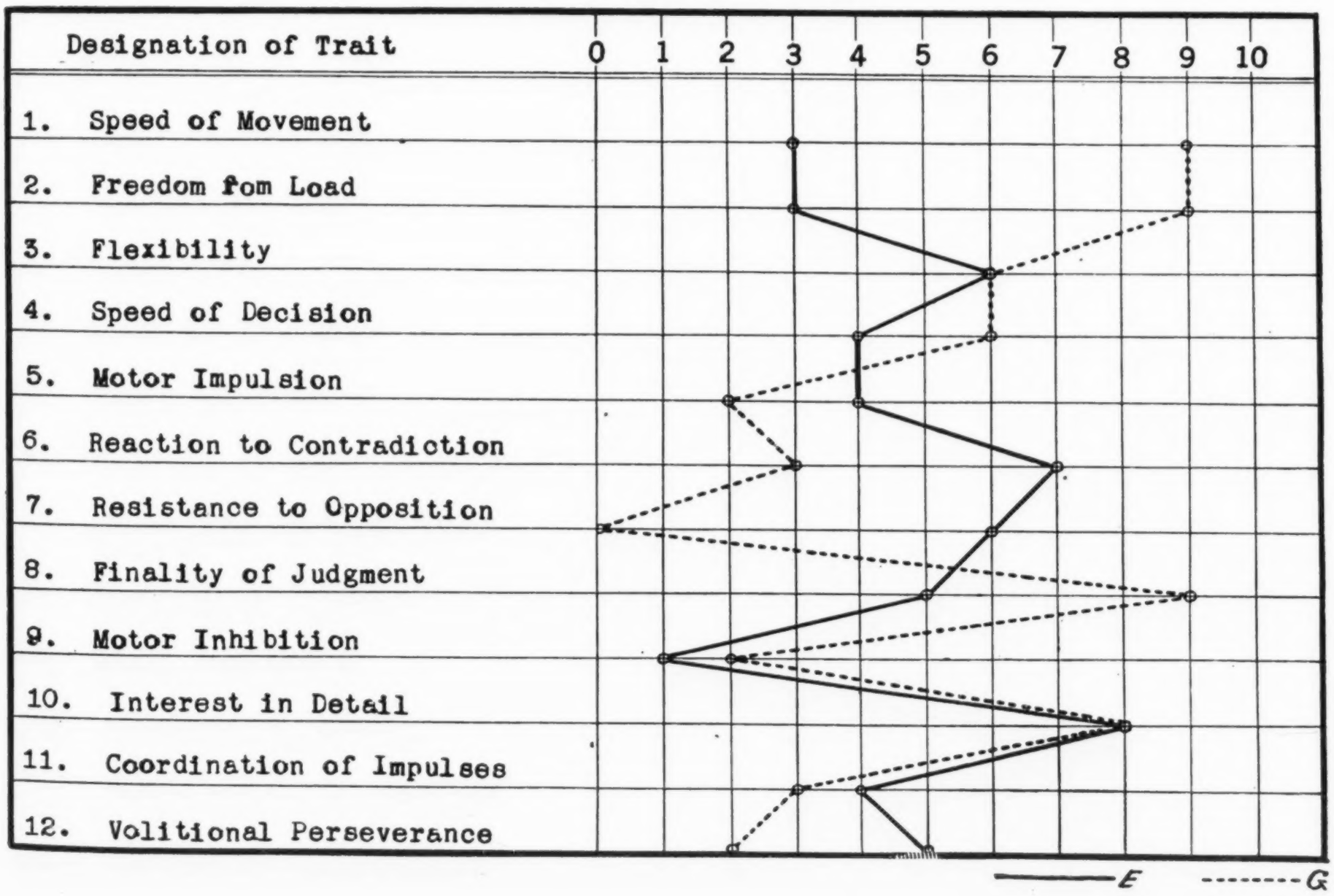
"E" gave many more individual reactions than "G" and deviated more widely from the normal. Her reaction time was also much slower. The indications are that "E" was overdoing her effort to appear individual and was not reacting normally. This is the only part of the test in which there seemed to be any suspicion of conscious effort on the part of these twins to appear different or peculiar.

10. *Motor tests.* About a year before these tests were given, "E" broke her right wrist and it was still somewhat stiff. This circumstance vitiates the motor tests to some extent, but in spite of the stiff right wrist "E" shows definite right-handedness though not so strongly as does "G". "E" is much slower in cutting out stars with both right and left hands, slower in wrist tapping and in finger tapping than "G", but in tracing, "E" is distinctly more proficient than "G". as well as in steadiness of hand movements.

Summary of Mental Tests and Conclusions

It is our intention at a later time to present in more complete and detailed form the results of mental tests of all of our cases of identical twins reared apart. Only a bare outline of the data can be presented in such an article as this and others in this series. From what has been presented, however, there may be drawn certain fairly clear-cut conclusions. These twins, remarkably similar after being separated at eighteen months of age and unknown to each other for nineteen years, have been profoundly modified by the very different educational careers. In every test of mental capacity, whether of so-called native ability or of achievement, "G", the more highly educated twin, has distinctly the

Table II
Downey Will-Temperament "Profile"



superior mind. Obviously, mental training improves the ability of an individual to score well on any sort of test, even such an one as the International Test in which no language is used and only degrees of brightness or mental alertness are supposed to be tested. In this test "G" was as superior over "E" as in most of those tests involving achievement. In the Stanford Achievement Test and in the somewhat advanced Otis Test, as might be expected, the scores of the twins were most different and in favor of the more highly educated twin.

In contrast with the great difference in mental power stands the fact that in all the tests of emotional traits and of temperament the twins give the impression of being remarkably and unusually similar. These tests are in their very nature open to wide fluctuations of performance. The same person on different days or at different times of the same day would produce different scores, and these differences would not infrequently be as great as are those of 'E" and "G". In a word, then, these twins show a very much greater similarity temperamentally than they do intellectually. One might conclude that the emotional environment was much more similar for the two twins than was the intellectual environment, and no doubt this is true. It might also be claimed that emotional peculiarities are more strongly inherited and less modifiable by environmental factors than are intellectual traits, and this would not be true. In any case, it would be fatal to generalize on matters of such importance on the basis of one case or even a few. The more cases of this sort we are able to study, the more likely we are to get at the truth of the matter, even if no two cases agree. In many respects the twins "E" and "G" agree with the twins "A" and "O" of our previous paper and disagree with Muller's twins "B" and "J" in which there was remarkable mental resemblance and more than ordinary temperamental difference. No doubt all these cases are correct in themselves. Which type of case is more nearly general, only further studies can decide.

One more case has been fully studied by us and the results will appear in this journal in the near future.

The Horse "Coming Back?"

Since 1918 and 1919, when the number of horses on farms in the United States reached the highest total ever recorded, a sharp decline has been in evidence. Last year the number of horses on farms was no greater than in 1890, and the reduction does not yet show any signs of ceasing. Some significance may be attached to the fact that the farm price of horses has turned slightly up since 1926 and 1927. Horse prices in 1925, in comparison with the average prices of all commodities, were at the lowest point since 1868. It is therefore possible that the corner has been turned, and that the recent slight upward trend indicates an increasing demand. The average age of all horses on farms has steadily increased within the last few years. It is therefore practically certain, says the United States Department of Agriculture, that colts and young stock will shortly be in greater demand. The outlook is for an increase in the prices of all good horses.

—*U. S. Dept. Agriculture.*

MULTIPLE EAR CHARACTER IN MAIZE*

C. K. McClelland and Geo. Janssen

Arkansas Agricultural Experiment Station

During the last few years the writers have observed peculiar monstrosities in several lines of inbred Jarvis Golden Prolific Corn. These peculiarities have become more pronounced during the last two years. This past year they have become so specific within certain strains that the normal type was practically excluded. The peculiar ear formations which are characteristic of this type may be of interest to corn breeders and it is for this reason that this form is here reported.

The odd strain is represented by several ears within the same husk or shuck. Figure 1 shows the type in question. It will be seen that this particular specimen carries six ears within the same husk. Two of these ears have well developed cobs with no grain. Apparently the silk of the various ears did not mature and protrude from the husk at the same time, and therefore did not become pollinated. So far as we could detect visually all of the ears within the husk had a normal cob, silk, and macrogametophyte. Many of these multiple ears within a common husk were inspected and it was found that every one contained from two to six or more ears, and that it is a specific character within this inbred strain.

Figure 2 shows a diagram of the ears within the husk. It will be noted that there is one general husk which envelops all six ears. Again it will be seen that in one case two and in another case three ears are enveloped in a common husk and that in turn each individual ear has a separate covering. This ear is the result of a prolific tendency manifested at one node of the stalk whereas in other types of prolific corn the tendency is shown by ear-shoots at several of the nodes. Many variations in the number of ears and method of enveloping may be noted among members of these individual strains.

Figure 3 shows several strains of prolific stalks of corn related to the above type. It will be seen that (a) has three ears attached to a common shank. If it can be assumed that the shank between the ears has shortened then a plant showing the characteristic of (b) would be produced. It will be seen that here the ears are very close together and that the group of three ears are more or less surrounded by two husks, these would appear to be analogous to the outer glumes of the oat spikelet. It is very possible that the shanks of these ears have continued to shorten to the extent where all the ears have become envelopd in a common outer husk. Such an assumption, namely, that the shanks have shortened is not entirely hypothetical since inspection of the mode of attachment of the multiple ears, reveals the fact that they originate from separate nodes of the same shank. But it seems that through the telescoping of the shanks the ears are placed closely together. The main shank then may be assumed to be analogous to the shank of ordinary corn and that the joints of the shank are the respective nodes from which the respective ears arise on diminutive shanks. This then accounts for the fact that each ear is wrapped in a separate husk.

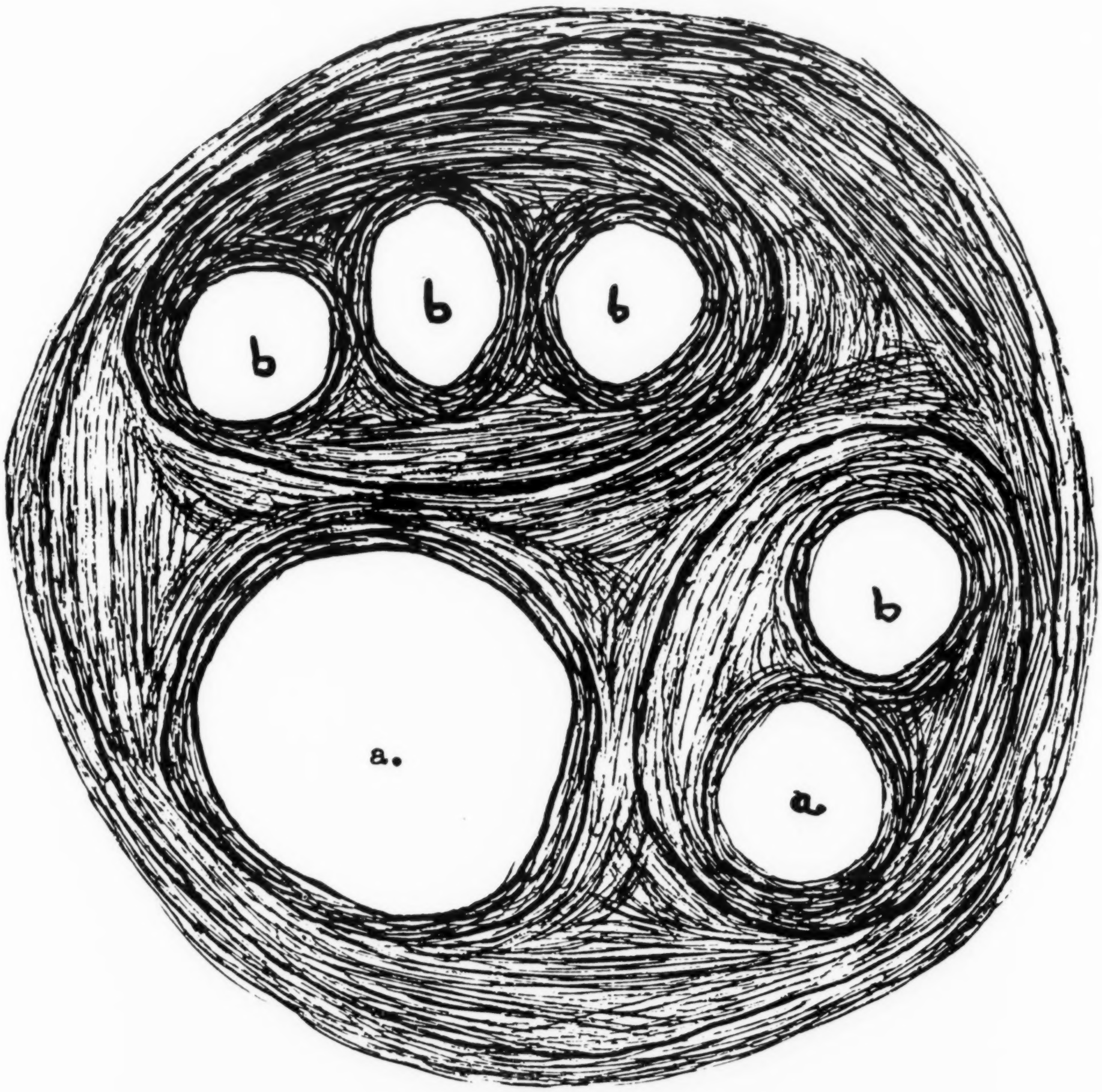
Such ears as those of (a) and (b) in Figure 3 are of rather frequent occurrence in any corn field, especially, however, in selfed strains. The lateral

*Contribution from the Arkansas Agricultural Experiment Station—published with the permission of the Director. Res. Paper 112—Journal Series—University of Arkansas.

MANY EARS TOGETHER

Figure 1

In this form of multiple ears each cob has its own husk, and outside is a common husk surrounding the entire group. Some of the ears are not fertile, as is indicated in Figure 2. The outer husks have been removed from the tip half of the group and the individual husks have been taken off some of the ears.



ARRANGEMENT OF EARS

Figure 2

Fertile ears are designated by *a*, infertile ears by *b*. The arrangement of individual and group husks is also shown.

ears are usually infertile. The ears shown at (c) and (d), or as enlarged in Figure 1, are not commonly found but may be an intensification of the tendency shown at (a) and (b). So rare are the (c) and (d) types that they were found only in one of several varieties selfed and only in one strain of the fifty or more strains within this variety. Further evidence of its rarity is the fact that the published literature† so far as the authors are aware, contains no reference to such a multiple ear character.

Strain 58-1-3 bore practically every ear of this type while the sister strains 58-3-2 and 58-8-3 had a considerable percentage of ears of the same type.

**This multiple ear type seems to be entirely different from the Branched Ear types referred to by J. H. Kempton: Heritable Characters in Maize—XIV—Branched Ears, in *Journal of Heredity*—Vol. XIV (6), 243-251. 1923.

(a) (b) (c) (d)

VARIATION IN FORMATION OF MULTIPLE EARS

Figure 3

Showing position of ears on a common shank, and the possible effect resulting through the shortening of this shank. (a) Long main shank with one terminal and two lateral ears. (b) Effect if shank is shortened.—Enveloping outer husks on either side. (c) All ears enveloped in one husk. (d) Semi-cross section of a multiple ear.

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That the sister strains both showed multiple ears is evidence of its heritable nature. Strain 58 had been selfed three years prior to the initiation of a progeny record, hence should be genotypically pure. It is planned that in the future a study of the mode of inheritance of this character will be made.

Selection for Fecundity in South Africa

THOUGH little recognized in the past, selection undoubtedly is a potent factor in human life and welfare. We are accustomed to think of selection as an experimental operation on plants and animals, but not as being applied to the human stock. As long as we remain unconscious of the effects of selection, we are on the same footing as the animals and plants. Selection works whether we know it or not, but it is only through a general understanding of the biological factors that the incidence of selection may be changed.

In the absence of experiments in human biology, we are dependent on observation and analogy. New countries have advantages from selection, in the more rigid elimination of the weak or defective. The pioneer period in America undoubtedly was a time of stringent selection, while conditions now have become much more favorable for the preservation of many who would not have survived in the pioneer period. The raising of large families under pioneer conditions is an evidence alike of the hardiness of the stock and of practical adjustment to the requirements of existence, whatever the privations may appear to have been from the standpoint of our present standards of living. The intensity of selection in South Africa appears to have been greater than in our colonial period, and a product of very high quality is claimed:

> Educate the average Boer, and the result is a man whose mentality, strength of character, energy, initiative and resource can compare favorably with the highest types of the Anglo-Saxon race. Many of the Boer Ministerialists now legislating in the Union Parliament, although mostly self taught, are men of extraordinary culture and capacity, and man for man they completely overshadow the intellectual forces of the British Opposition. My experience has impressed upon me a profound conviction that the average Boer—however uneducated he may be—is possessed of natural abilities which only need development to make him intellectually the equal of the best European minds.
>
> Nor is it surprising that this should be so, for the average Boer, whether educated or uneducated, is farm bred, and he has lived most of his life in the open air, and if we examine the conditions of his birth and breeding, we always find that the magnificent stature which surprises us afresh every time we look upon him, represents a practical illustration of the truth of Darwin's doctrine of the survival of the fittest. The truth is that the average Boer farm house is no nursery of weaklings. The surroundings are so filthy, insanitary and rough, and the Boer housewife's ignorance of the simplest duties of motherhood is so dense, that although many babies are born, few outlast their infancy. Child mortality on the veld is positively appalling, and were it not that the Boers are enormously prolific the race would have long since tapered towards extinction. The secret of the astonishing physical and mental virility of this people is that death promptly and remorsely culls out the inefficients. Those only survive who are born strong and hardy enough to be disease-proof from their birth, and that is why the stranger to this country searches in vain for an undersized or sickly Boer. There are many such but they are infants, and nearly all are underground.
>
> . . . . . The woman who commands universal Boer admiration is the sturdily built, well-sexed house frau,—the big feeder and big breeder. The following account of an exalted specimen of the popular type was published in a recent number of the *Volksstem*:—
>
> Theila M. de Beer: born October 20th, 1832, married at 18, Petrus Jacobus Lubbe, 1 child. Husband died in two years. After being 10 months a widow married Noclaas

husk. (d) Semi-cross section of a multiple ear.

Marthinious Pretorious, a widower with 3 children. Lived with him 17 months when he died, leaving her with 4 children. After 5 months widowhood she married David Stephanus Pieterse, a widower with 7 children. Lived with him 11 years and bore 7 children. He died. After 5 years' singleness married Daniel Lodewiekus Cronje, a widower with 8 children. She lived with 11 years and had 4 children. He died. Five years later she married Hendrik Klopper. Lived with him 11 years and bore 10 children. He died. Two years later married Coenraad Hendrick von Wijk, a widower with 5 children. Lived with him 11 years and bore him 4 children. He died. Theila M. de Beer is still alive, aged 78 years. There are 50 persons living who call her mother. She has 270 grandchildren.—PRATT, AMBROSE. The Real South Africa, Pp. 89, 90, 91 and 92.

Books Received

BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the readers of the JOURNAL *will be reviewed in later numbers.*

DAS RAUMJAHR: "The arrangement of the Stuff of Life." *By* HANS SCHLIEPER. Pp. 360. Six parts. Jena, Eugen Diederichs Verlag, 1929.

STATISTISCH-BIOSTRATIGRAPHISCHE UNTERSUCHUNGEN AN MITTELJURASSISCHEN AMMONITEN UBER ARTBEGRIFF UND STAAMMESENTWICKLUNG. *By* ROLAND BRINKMANN. Pp. 249. Five parts. 5 plates, 56 text figures and 129 tables. Price 22 Marks. Berlin, Weidmannsche Buchhandlung, 1929.

THE BURNS WE LOVE: *By* ROBERT CAMPBELL MACCOMBIE AULD. "A First Attempt to Obtain a Better Understanding of the Mission, Message and Meaning of the Poet of Humanity and of the Common Cause." Pp. 238, 1 portrait, 12 full-page illustrations. 21 chapters. New York (and Ayr), The Tlloway Press, 1929.

HOME AND FAMILY, in two parts: Part I, The Home Guide; Part II, The Pioneer Family Record Reference Chart. Copyright, 1928. SERVICE SECTION NUMBER ONE: Prepared for Descendants of Thomas Coram, Richard Hill McRae Swann, Daniel Brunson, Frederick Watson, Allen Rigsby and Johnson Blair. July 4, 1925. THE GEORGIA BRANCH OF THE VIRGINIA CLAYS AND THEIR CELEBRATED COUSINS, with Harden and Jones Genealogies and Notes of Related Families: For Service Section No. 1, "Home and Family." July 4, 1926. ANCESTRY AND POSTERITY OF DR. JOHN TALIFERRO AND MARY (HARDIN) TALIAFERRO, with notes on Berryman Newton, Beheathland, etc. July 31, 1926. HISTORIC GEORGIA FAMILIES, 1928 Brochure. MEMORIES OF HOME AND FAMILY: A simplified and perfected edition of "The Pioneer Family Record Reference Chart," embodying improvements suggested by four years' actual use. 1928. All *by* L. W. RIGSBY. Cairo, Ga., The Pioneer Institute.

THE GENETICS OF THE DOMESTIC FOWL

Memoirs of the Anikowo Genetical Station, 1926

Abstracted by L. C. DUNN *from the translation of* B. F. GLESSING

Part II. The Genetics of Leg Feathering

LEG feathering in the fowl presents one of the most difficult tests for Mendelian analysis. It is affected by many genes, so that it is necessary to work with perfectly pure material.

The condition of the shanks varies through all transitions from clean to heavily feathered. Several types may be distinguished, but each type is only an average around which fluctuations occur.

Leg feathering is fully apparent in the down even in unhatched chicks, and is described most accurately at this stage. Only rarely does the adult description vary from the down description. The descriptions used in all that follows are based on leg feathering in the baby chick.

Types of Leg Feathering

(1) "Heel-tufts" (*Plate 18, Figure 3*).* This is the weakest type of leg feathering, often occurring in "clean-shanked" breeds. The tarsus and toes are entirely bare, and careful examination is required to detect (more easily in down than in the feathers) some rudimentary feathers on the inner surface of the heel.† (See Figure 5.)

(2) "Outer stubs." The lowest type of leg feathering proper consists of one or two tufts of down on the *outer* side of the tarsus, or near the base of the two outer toes. The location of these stubs on both feet is strikingly symmetrical. Such symmetry is characteristic of all of the types of leg feathering.

(3) Type 1002 (Tarsal stripe). This type, which is connected with the above by continuous gradation, is characterized by a stripe of poorly developed down on the tarsus, and *only there.*

(4) "Tip tufts." (*Table 18, Figures 5 and 6.*) Continuous transitions connect type 1002 with this more heavily feathered type, in which a thick stripe of down covers the *outer side* of the tarsus and the whole of the outer toe. The middle toe is bare except the tip. on which are one or several tufts of down, always on the *outer surface.* This distinguishes this type from other tufts on the middle toe, which always are on its upper surface. The inner surface of the tarsus always is absolutely bare. Small tufts may occur in the angle between outer and middle, and middle and inner toe.

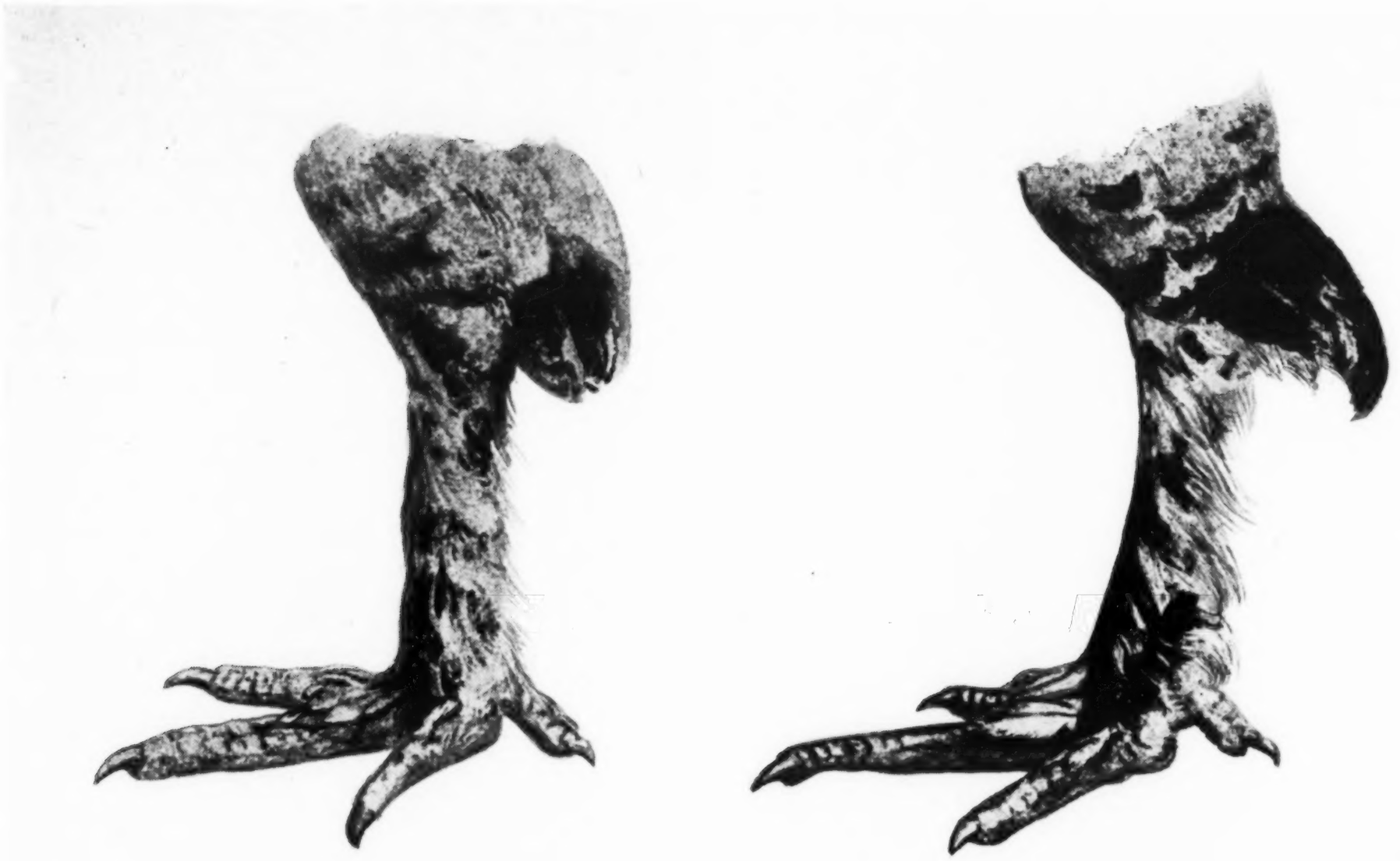
(5) Cochin type. (*Plate 18, Figures 7 and 8.*) In this type, which intergrades with type 4, the outer surface of the tarsus and the inner and middle toes are covered with very thick down, in which the outer toe is entirely hidden. Inner surface of tarsus and two remaining toes usually are entirely bare. Occasional isolated tufts on first and second toes.

(6) Faverolle type. This is distinct from all the preceding. Although similar to the "tip tuft" type in other respects, it does not show tip tufts, since on the middle toe the down is thinly and fairly evenly distributed, and is even thinner at the tip. The inner tarsus is bare.

(7) Pavloff type. (*Plate 18, Figures 1 and 2; Plate 12, Figures 1 and 2.*) This is connected by gradual transitions with type 1002, and represents increased feathering of the tarsus and toes, and the invasion by feathers of the inner surface of the tarsus. It

*Plate and figure references in italics are to the original work.

†This is the area just below the tibio-tarsal joint (the "hock" joint of poultrymen).



RECESSIVE LEG FEATHERING

Figure 4

Recessive leg feathering is distinguished from Cochin leg feathering by the presence of feathers on the inner surface of the tarsus and in having uniform feathering on all toes. The outside of the leg is shown at right, the inside at the left. Figures 4, 5, and 6 are redrawn from Serebrovsky's Plate 18: Nos. 1-6, inclusive.

is distinguished from the Cochin type by (a) feathering on the inner surface of toes; (b) uniform and not very heavy feathering on *all four toes;* and (c) a distinct difference in the grade of feathering of the tarsus from that of the toes.

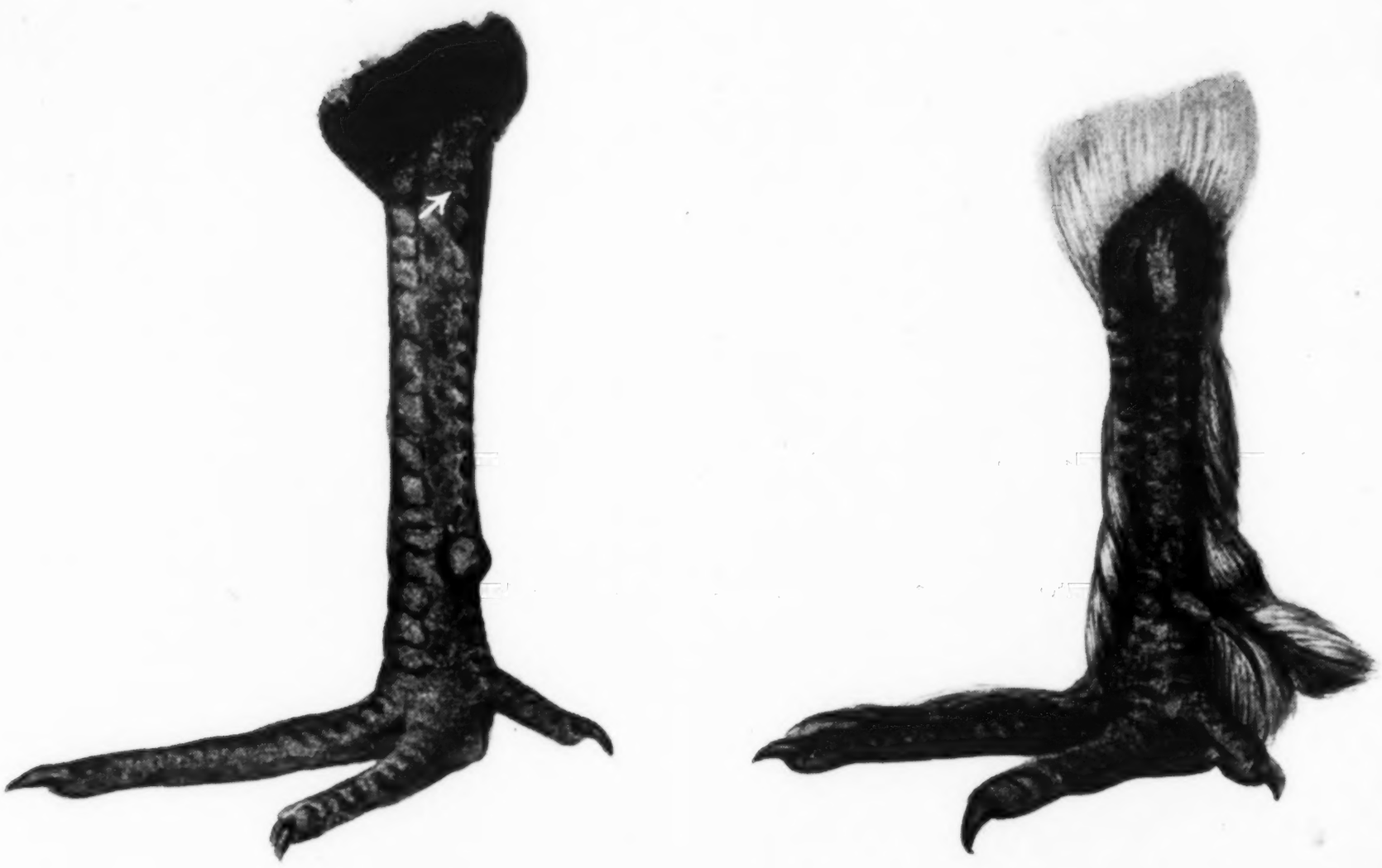
The investigations involving these several types of leg feathering are not yet complete, although several obscure points have been cleared up.

Inheritance of Heel Tufts (Susti* Gene)

The best data on the inheritance of heel tufts were obtained from a family of Wyandottes and Brahma-Wyandotte hybrids. Mendelian behavior of heel tufts was noted in 1920 in a cross of a hybrid rooster (♂ 612) with Wyandotte ♀ 622 (heel tufts) and ♀ 663 (clean). Female 622 had 19 chicks, 9 or 10 with heel tufts, 9 without. Female 663 (clean) produced only chicks without heel tufts. Later by a Pavloff-Orloff cock ♀ 663 gave 10 chicks, one with heel tufts. Since isolated cases of down on the heels similar to heel tufts are found in nearly all families, 663 is assumed to be pure for bare heels.

A similar type of heel tufts was found in a family of Light Brahmas. A Brahma male by female 663 gave 5 chicks, all with heel tufts. Two of these, male 1210 (*Plate 18, Figure 4*) and female 1223, gave both clean legged and heel tufted progeny (cf. Table 1). In the table are included fowls 614, 622, 1210, 1223 heterozygous for

*For an explanation of Serebrovsky's system of gene nomenclature, see the preceding article of this series, p. 511 of the volume 19.



HEEL TUFTS

Figure 5

At left is shown the "heel tuft" of Partridge Wyandotte 614; on right, the tuft of a Wyandotte by Brahma hybrid. The heel tufts are located just below the hock joint, indicated by the arrow.

the assumed gene, *susti*. Pullets 3307 and 3451 were daughters of 614. Number 3451 was bare heeled, but probably carried *susti*, since when crossed with 1210 it gave 13 *susti* to 4 *asusti*, very near to the three-to-one ratio.

Female 664, Wyandotte, also was clean legged, but was not examined when young. When crossed with 1210 and 614 it gave 40 *susti* to 17 *asusti*, nearly a three-to-one ratio, so it probably was heterozygous for *susti*. When crossed with *asusti*, however, it did not give *susti* chicks, so it is placed in the Ss × ss portion of the table. Female 1033 was a daughter of the same Brahma cock and Faverolle hen. Male 612 and male 3303 had no heel tufts, but 3303 produced some chicks with heel tufts.

The agreement between actual results and theoretical expectations in Table 1 justifies the assumption of the presence of *susti* in some Wyandottes and Brahmas. A certain surplus of *susti* forms probably may be explained by the presence of sporadic cases of heel tufts. A very few cases of this are observed in nearly all crosses.

Susti is independent of other genes for leg feathering, and is not sex-linked.

Inheritance of Recessive Leg Feathering (Pavloff type)

(*asuso gene*)

The chief data on recessive leg feathering were obtained from the crossing of a feather-legged Pavloff cock No. 157 (*Plate 12, Figure 1*) with leg-feathered and clean shanked pullets. He was crossed with the following clean-shanked pullets: Female 15 Indian game, female 177 Minorca, and females 173 and 179 Orloff. The fifty chicks lacked entirely the Pav-

loff leg feathering; 30 were clean shanked, and 20 had traces of feathering in the form of one or two tufts of down on the outer side of the heel, never exceeding type 1002. Clean shanks were hence dominant with the qualification that 40 per cent of the heterozygotes developed weak leg feathering.

An F_2 of 404 chicks was distributed as follows:

111 or 27.5% Pavloff leg feathered
204 entirely clean shanked
89 weak leg feathering.

The segregation of the Pavloff from the other types was sharp and there were no transitional forms between the Pavloff and "weak" types. The highest grade of the "weak" type only slightly exceeded type 1002. This was, therefore, a typical monohybrid cross, Pavloff leg feathering segregating as a recessive and the "weak" type being heterozygous for clean shanks.

The proportion of weak leg feathered chicks to clean shanked ones was lower in both F_1 and F_2 of the Pavloff-Orloff cross than from the other crosses. The proportions are shown in the table below*.

It is possible that the Orloffs had a weak supplementary inhibitor, or that the Minorca and Indian had a weak intensifier of leg feathering, but there is insufficient evidence at present.

On the basis of the monohybrid F_2 the following description of the gene is given: *Suso,* gene for clean legs, suppresses Pavloff type of leg feathering. *Suso* homozygotes in the absence of dominant leg feathering genes have clean shanks and toes. In heterozygous state, dominance of *suso* is not always complete and varying percentages show weak leg feathering. On an average, about 40 per cent of *suso* heterzygotes showed traces of leg feathering.

The results of many other matings in which this gene showed Mendelian behavior are given in Table 2. Expected numbers are calculated on the theory that 40 per cent of *suso* heterozygotes show weak feathering, while 60 per cent are clean. [*T*=*suso* (inhibitor), *t*= *asuso.* (Pavloff type.)] The actual total always is close to the theoretical expectation, the few deviations being unimportant. It is concluded that *suso* shows typical Mendelian behavior, is very convenient for experimental work, and that this phase of the genetics of leg feathering is fairly clear.

Inheritance of 1002 Type Leg Feathering

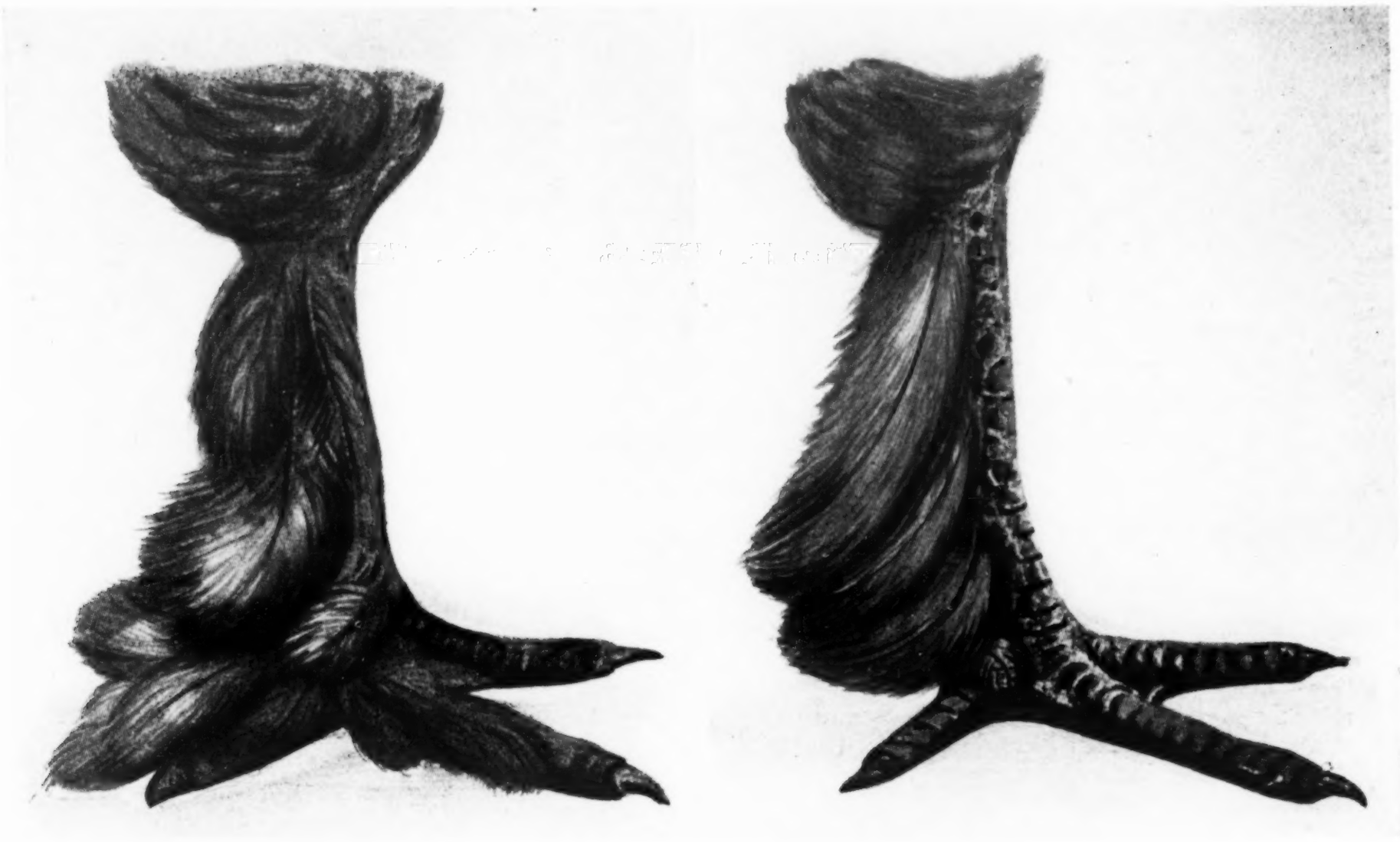
Hen 1002 (tarsal stripe of feathers) was from a Plymouth Rock mother and a male of mixed breed. By a purebred English game it gave 3 chicks, one feathered like 1002, the other (♀1227) clean. Female 1227 by English game cock 605 and 3303 (father and son) gave 25 clean and 12 chicks with weak leg feathering. Female 1002 by male 2389 (*suso* heterozygote) gave 14 chicks, of which 2 or 3 were typical *asuso* forms (Pavloff leg feathering). This shows that hen 1002 was a *suso* heterozygote. In the 1002 family nearly all *suso* heterozygotes show traces of leg feathering.

Suso probably was in the wild type fowl and *asuso* appeared as a recessive mutation. Little can be said about its origin. *Asuso* forms are found in

*Inheritance of Pavloff Type Leg Feathering

	F_1			F_2 (From Table II)			% calculated† from Table II p. 48
	clean	weak	% weak	clean	weak	% weak (from text)	
Pav. × Orloff	16	6	27%	54	14	29	20
Pav. × Minorca...	9	7	44%	39	23	53	37
Pav. × Indian	5	7	58%	111	52	47	32

†The percentages quoted in the text, from which conclusions are drawn, differ rather widely from the percentages as calculated from the data as given in Table II.



TIP TUFTS

Figure 6

In tip tufts the middle toe is almost entirely bare. The outer side of the tarsus is feathered. The tip tuft consists of just a few feathers on the outside of the middle toe.

Pavloff, Sultan, English Bantam, some mixed Russian breeds in the Tulsky and Orloff districts and in the Orloff.

Suso has not shown linkage with any other gene, the following associations having been tested: *tifa* (black) 229 chicks; *gidu* (normal nostrils) 166 chicks; *weque* (pea comb) 133 chicks; *wene* (rose comb) 14 chicks; *rete* (polydactyly) 121 chicks.

Dominant Leg Feathering (Faverolle Type)

Susta Gene. Table III

Faverolle leg feathering differs from the Pavloff type by the bare inner surface of the tarsus, the heavy feathers on the outer toes, and the absence of feathers on one or two toes. Standard Faverolles should not be too heavily feathered, and for this reason many of them are heterozygous and throw clean shanked chicks when crossed with clean shanked birds.

Three pullets from the cross of clean by Faverolle (668, 1023, 2437) were crossed to clean shanked cocks (English game cock and Orpington-Orloff cock 2015, tested pure for clean shanks), and gave 44 clean and 42 leg feathered, very close to the 1 : 1 ratio. Four other heterozygous pullets, two pure Faverolle and their two daughters (out of Orloff) were crossed with Orloffs 57 and 3246 heterozygous for *suso*. Allowing for weak feathering on 40 per cent of *suso* heterozygotes, the expected proportions from this cross were 1.6 clean and 2.4 feathered, or, out of the 63 chicks obtained, 25.2 clean and 37.8 feathered. The actual result was 21 clean and 42 feathered, which agreed with expectation.

Pavloff-Faverolle Cross

Pavloff male 157 was crossed with a typical Faverolle pullet (No. 182), and produced 30 chicks, all with feathered legs varying from the Faverolle type (6 chicks) to the 1002 type (12 chicks). The Pavloff type was not noted on any of the progeny. Desig-

nating *suso* (inhibitor of leg feathering) by *T* and *susta* (dominant leg feathering) by *L,* it is assumed that the Faverolle was *TTLL* and the Pavloff *ttll.* The F_2 should therefore consist of 2.2 clean, 4 Pavloff or more heavily feathered type, and 9.8 Faverolle or weak type out of each 16, by independent recombination of *T* and *L* and the development of weak leg feathering in 40 per cent of the *Ttll* chicks. The F_2 results compared with those expected are shown below*.

The chief departure was in the surplus of clean shanked chicks from 2044 × 2313. It is possible that this pullet was of genotype *Ttll* rather than *TtLl.* In all cases, the Pavloff-Faverolle cross agreed in general with the hypothesis that the Faverolle was *TTLL* or sometimes *TTLl.*

Leg Feathering in Orloffs

The standard calls for clean shanks in the Orloff breed, but some rather poor specimens of this breed obtained in Moscow (specifically male 57 and female 632) had weak leg feathering of the 1002 type. These were not *suso* heterozygotes, since when bred together they produced no *asuso* (Pavloff type) chicks out of 8. Male 57 by a pure *suso* (*TT*) pullet gave 12 clean and 4 weakly leg feathered chicks. One of the latter chicks, male 2302, by four clean-shanked sisters (33, 2301, 2303, 2306) gave 77 clean and 29 leg feathered (weak)[1] (Figures quoted from text; table shows 107:26). Instead of the 1:1 ratio expected from the last cross, there was obtained a ratio of about 2½ to 1. It was then assumed that the Orloff cock had a latent *asuso* gene and when crossed with a daughter 2717 (weak leg feathering) he gave 1 Pavloff out of 15 chicks. Female 2717 also proved to carry *asuso.*

Three weakly feathered progeny of male 57 (male 2346, females 2977 and 3317) also were tested for *asuso.* Male 2346 by Pavloff female 2310 (*Plate 9, Figure 1*) gave 1 clean, 2 weak, and 3 typical Pavloff type chicks. Female 2977 by male 2302 (brother) gave 8 clean, 8 weak, and 6 Pavloff type. Female 3317 by 2302 gave no Pavloff type chicks out of 22. Male 57 by female 632 and male 2302 by female 3317 gave a total of 11 clean, 19 weak, and no Pavloff type. The pullets hence were homozygous for *suso* and their leg feathering was of the dominant type. The data on this family is summarized in Table IV.

These experiments indicate the way in which, by selection and progeny testing, a character which mars the standard type may be eliminated from the stock.

Leg Feathering in a Family of Bantams

Of two Porcelain Bantams from a fancier, one (female 645) was clean shanked, the other (female 644) had leg feathering of low grade Pavloff type. These were crossed with Bantam male 613 with traces of leg feathering, and later with male 618 with much more pronounced leg feathering, then with male 2328 (Pavloff type), male 2884 (*suso* heterozygote), and male 2978 (heterozygous in *susta*-dominant leg feathering). The results are shown in Table V, compared with expectation on the assumption that the Ban-

*Results of Pavloff-Faverolle Cross

Cross	Clean		Faverolle or weak type		Pavloff type	
	Found	exp.	Found	exp.	Found	exp.
F_1 2044 × F_1 2046	8	7.6	38	23.6	19	13.8‡
" × F_1 2378	4	4.1	15	18.4	11	7.5
× F_1 2313	10	5.5	20	24.5	10	10.0
	22	17.2	73†	76.5	40	31.3

†63 in the original.

‡This table contains typographical errors since the totals of found and expected in the first line differ by 20 and since the combined results of the first two crosses are given in the text as: 13:43:10 whereas the totals from the table are, by addition: 12:53:30.

tams used were of the genotypes listed: i. e., male 613 (trace of leg-feathering) heterozygous in recessive (Pavloff) leg feathering and *asusta;* female 644 (Pavloff type) pure for recessive leg feathering, heterozygous in dominant leg feathering; female 645 (clean) heterozygous in recessive leg feathering and *asusta.* The last apparently belonged to the 60 per cent of *suso* heterozygotes, which do not show any leg feathering. One pullet from these experiments (1202) had at birth one clean and one feathered leg. The leg feathering disappeared with maturity. By *asuso* 2328 it gave 20 clean, 12 with traces of leg feathering, and 1 *asuso,* and hence had the formula *TTll.* It was genetically clean shanked, and its weak leg feathering must have been phenotypical.

Leg Feathering Among Progeny of Male 612

Although most cases of leg feathering could be interpreted by the Mendelian behavior of *suso* and *susta,* these two genes are insufficient to explain all cases.

Male 612 (purchased), heterozygous in other Orloff characters, had weakly feathered legs. By clean shanked pullets (2 Wyandottes and 4 Langshans) and 1 Plymouth Rock, he produced 84 leg feathered and 36 clean shanked chicks. No scheme involving only *suso* and *susta* fits the case, and it is possible that male 612 was heterozygous in two dominant genes for leg feathering, although one other cross in which he participated did not support this conclusion. The case remains unexplained.

Leg Feathering in Braham-Wyandotte Cross

A light Brahma male 606 with heavy external leg feathering was crossed with Partridge Wyandotte pullet 663 (clean shanked). The F_1 (5 chicks) all had pronounced leg feathering with "tip tufts" on the middle toe (*Plate 18, Figures 4 and 5*). (See Figure 6.)

The F_2 (F_1 male 1210 $\times$ F_1 female 1223) consisted of 12 chicks with feathered legs, of which 10 had tip tufts.

The backcrosses of F_1 female 1223 by male 3303 (clean) gave 10 feathered and 4 clean. while F_1 male 1210 by clean-shanked Wyandottes (622, 664, 3307, 3451) gave 78 feathered and 23 clean, almost an exact ratio of three feathered on one smooth. This result cannot be explained by the two genes already used, *suso* and *susta,* and it must be assumed that two dominant leg feathering genes are involved, *susta* and a second provisionally designated *susu.* The expectations in Table VI are calculated on this assumption. The effects of *susta* and *susu* are not as yet distinguishable with certainty, although it is possible that *susu* determines the "tip tuft" type of feathering. In this type (although probably not in the Brahma-Wyandotte) the outer toe is reduced, giving rise to brachydactylism. No linkages of the dominant leg feathering genes with other genes were noted.

Reviewer's Notes

Since the original paper does not refer to other work on the inheritance of leg feathering, it is perhaps well to point out that the genes for "heel tufts" (*susti*) and recessive leg feathering (*asuso*) are here described and established for the first time. Poultry literature contains numerous references to the occurrence of stubs and traces of leg-feathering on the legs of clean shanked breeds, and since these are disqualifications in standard bred poultry, several attempts have been made to eliminate such characters, but until now there has been no successful attempt at a genetic analysis. Heel tufts should be a useful gene for use in poultry genetics since it occurs on the inner surface of the shank, which usually is bare, hence it can be distinguished readily in other feather legged types.

The recessive gene for leg feather-

ing also appears to be new, although several investigators have found clean shanked fowls which bred as though they contained a gene for dominant leg-feathering which was suppressed by an inhibitor of the *"suso"* type. The results which led Serebrovsky to assume two dominant leg-feathering genes in the Brahma-Wyandotte cross agree with Davenport's (1909) data as analyzed by Punnett and Bailey (1918) and with Dunn's (1927) data. In both of these latter cases two duplicate dominant genes for leg-feathering were found in fowls with heavily feathered or booted shanks (Brahmas, Silkies), while Punnett and Bailey also showed that the less extensive leg-feathering of the Langshan probably was due to a single dominant gene. The careful observations and the resulting morphological distinction between different types of leg-feathering also are new and helpful in the analysis of these rather complex characters.

The conclusions regarding the expression of the gene for recessive leg-feathering, on the other hand, indicate a need for further analysis since the occurrence of leg-feathering in 40 per cent of the heterozygotes does not agree with the usual understanding of the term recessive, and indicates the existence of a further problem rather than the solution of one. In this connection the differences between the results obtained when Pavloff was crossed with three clean shanked types are of doubtful significance in view of the small numbers involved and the uncertainty as to whether the text or table gives the correct data.

It is unfortunate that several errors, probably typographical, appear in the tables and text. Attention has been drawn to two such in the footnotes on Pp. 114 and 116. In Table IV of the original, the second line of totals reads 65:20 found compared with 68:17 expected. The actual totals are 95:17, which makes a serious departure from expectation. Where it is thus uncertain that the author's data have been correctly given, detailed criticism is not to be attempted.

In general, it appears to the reviewer that the evidence on the purity of the parent types and on the behavior of extracted recessives is insufficient to make the results conclusive. Obviously, with the mixed material at hand a complete analysis would have required the establishment of pure types and the testing of the hypotheses on pure material, and this could not be done within the range of two generations and on material which was being bred for many other purposes as well.

THE GAGE PEACH

H. W. Anderson and M. J. Dorsey,
University of Illinois, Urbana, Illinois

An interesting peach, which has attracted considerable attention locally, has appeared in Illinois. The fruit is almost, if not, identical with Elberta, but the tree has a peculiar low, spreading habit of growth. These characteristics have led to the local use of the name "Dwarf Elberta." However, since this name is somewhat misleading because the tree is not a dwarf, the name Gage seems more suitable for the variety.* The likeness of the fruit to Elberta, the habit of growth of the tree, and the high degree of resistance to *Bacterium pruni* have all contributed toward increasing the interest of peach growers in this variety.

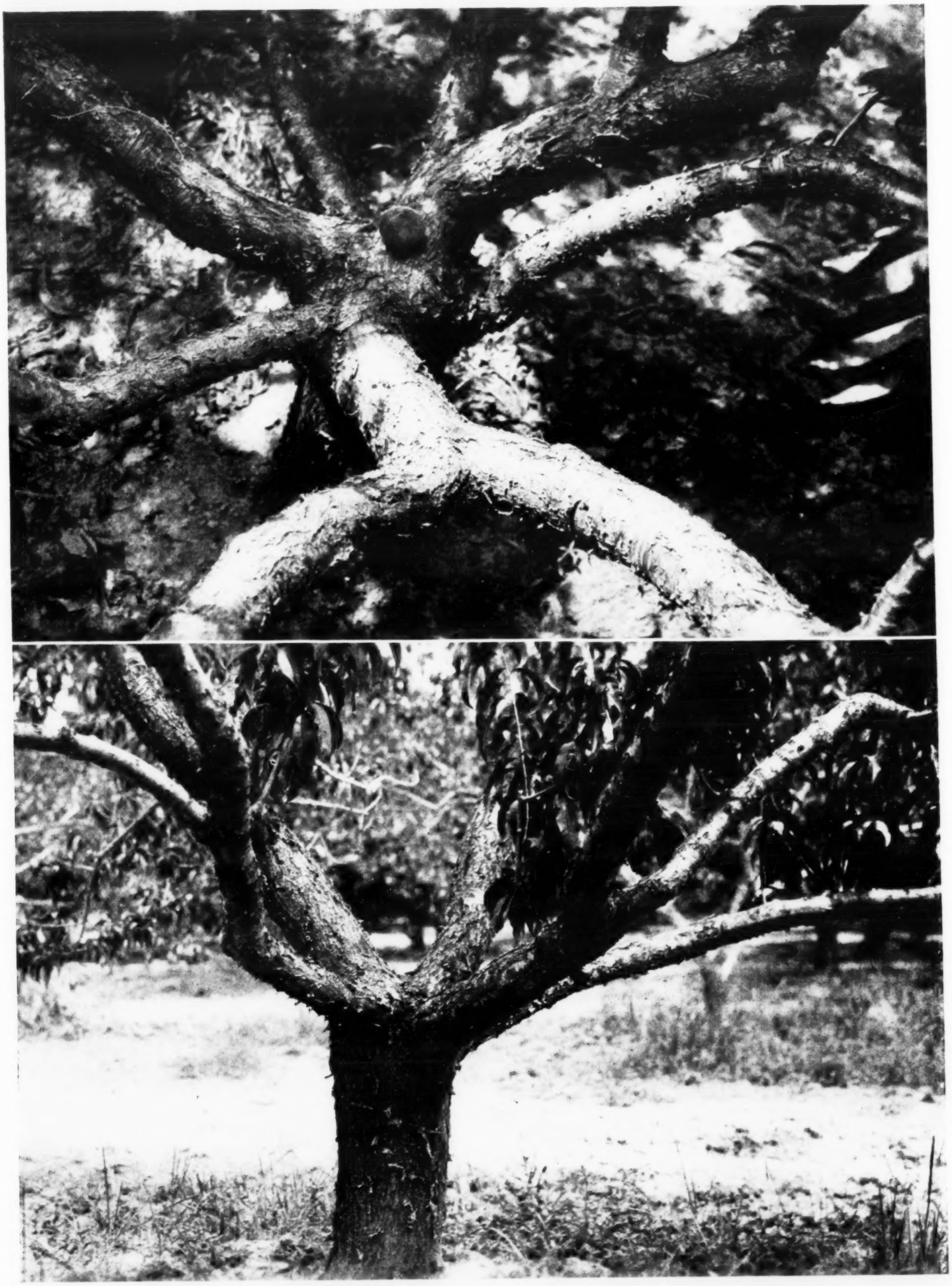
The Gage peach first came to notice about twenty-five years ago in the orchard of Mr. John A. Gage near Texico, Illinois. When first noticed "three to five trees" were found, about four years after planting, in an orchard supposed to be Elberta because the bud sticks were cut originally from trees thought to be of that variety. Propagation was begun as early as 1912 and trees were sold locally to a limited extent in 1915 and 1916. At the present time, a number of growers in Ilinois have limited plantings and the new variety is being given a commercial test under a variety of conditions.

The tree of Gage is naturally spreading, largely because the framework branches form wide angles with the trunk (Figure 7 *A*). The diameter of the top of a twelve-year-old tree was 21 feet, but the height was only 11 feet. There has been but little pruning done to this tree, so the natural growth had not been modified to a great extent. Smaller trees show a similar tendency in growth (Figure 8 *A*). In spite of the wide angles, the limbs do not break with heavy loads of fruit because they are well buttressed at the union with the trunk and the wood is tough. The characteristic branching of the older trees can be seen in Figure 7, *a*, which is a photograph of the head taken from above. Figure 7, *b*, also shows the relatively wide angles of the scaffold branches and the strong union with the trunk. The difference in the habit of growth between Gage and other varieties will probably make wider planting necessary while the pruning cost will be somewhat less because of the reduced growth rate.

When compared with Elberta, the bark of Gage, especially on the trunk and larger limbs, is decidedly darker in color. As the trunk increases in diameter the outer bark separates into relatively small scales which gives the trunk a smoother appearance than many of the other varieties even though some of the scales are persistent (Figure 7, *lower*). The terminal growths are seldom overvigorous, largely because of the short internodes (Figure 8 *c*). The leaves are thick and leathery and, with the same nitrate applications, appear much darker in color than either Elberta or J. H. Hale growing alongside. This difference, however, does not seem to affect maturity in the fall to a great extent.

Gage blooms two to four days later than Elberta, which may be a slight advantage some reasons but a disadvantage in others. When fruit buds survive the winter in sufficient numbers, the set is heavy, and many of the branches show a tendency to bear in clusters. The June drop is generally light. From the evidence at hand, this variety appears to produce a strong flower and to set fruit under unfavorable conditions much better than many of the others.

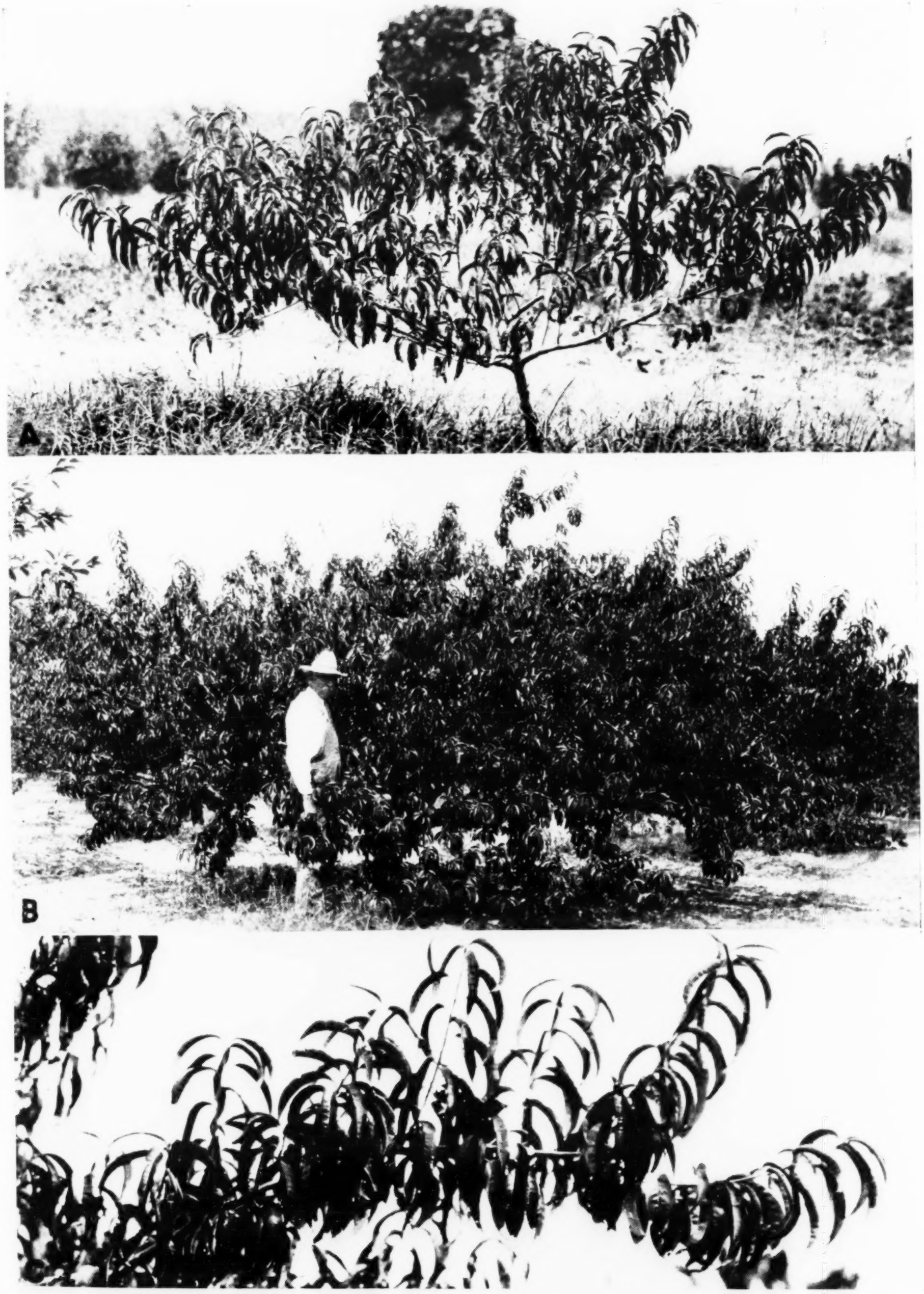
Trans. Ill. Hort. Soc., 60:452. 1926.



BARK AND BRANCH CHARACTERISTICS

Figure 7

Upper Photograph—A view of the head of the tree taken from above. *Lower Photograph*—A typical trunk showing the bark characteristics and strong unions of the scaffold limbs.



THE GROWTH HABIT OF GAGE

Figure 8

Photographs of trees when two years old (*A*) and ten years old (*B*). *C* is a typical branch tip showing the short internodes of the branches.

Gage Elberta

SIMILARITIES OF FLESH CHARACTERISTICS

Figure 9

The fruits of the two varieties are practically indistinguishable—rather a strong indication that the Gage arose by mutation from the Elberta.

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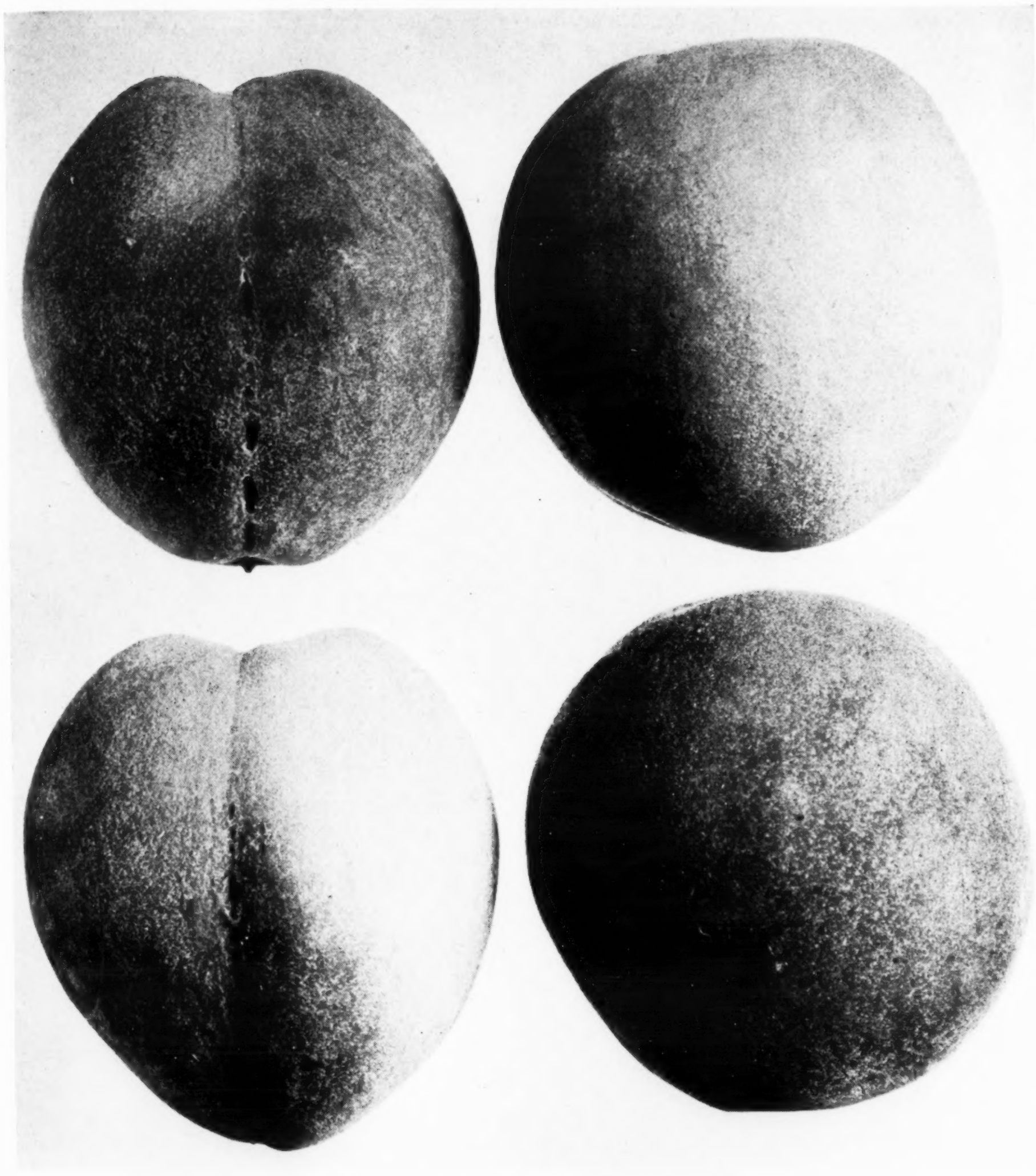


GAGE AND ELBERTA FRUITS

Figure 10

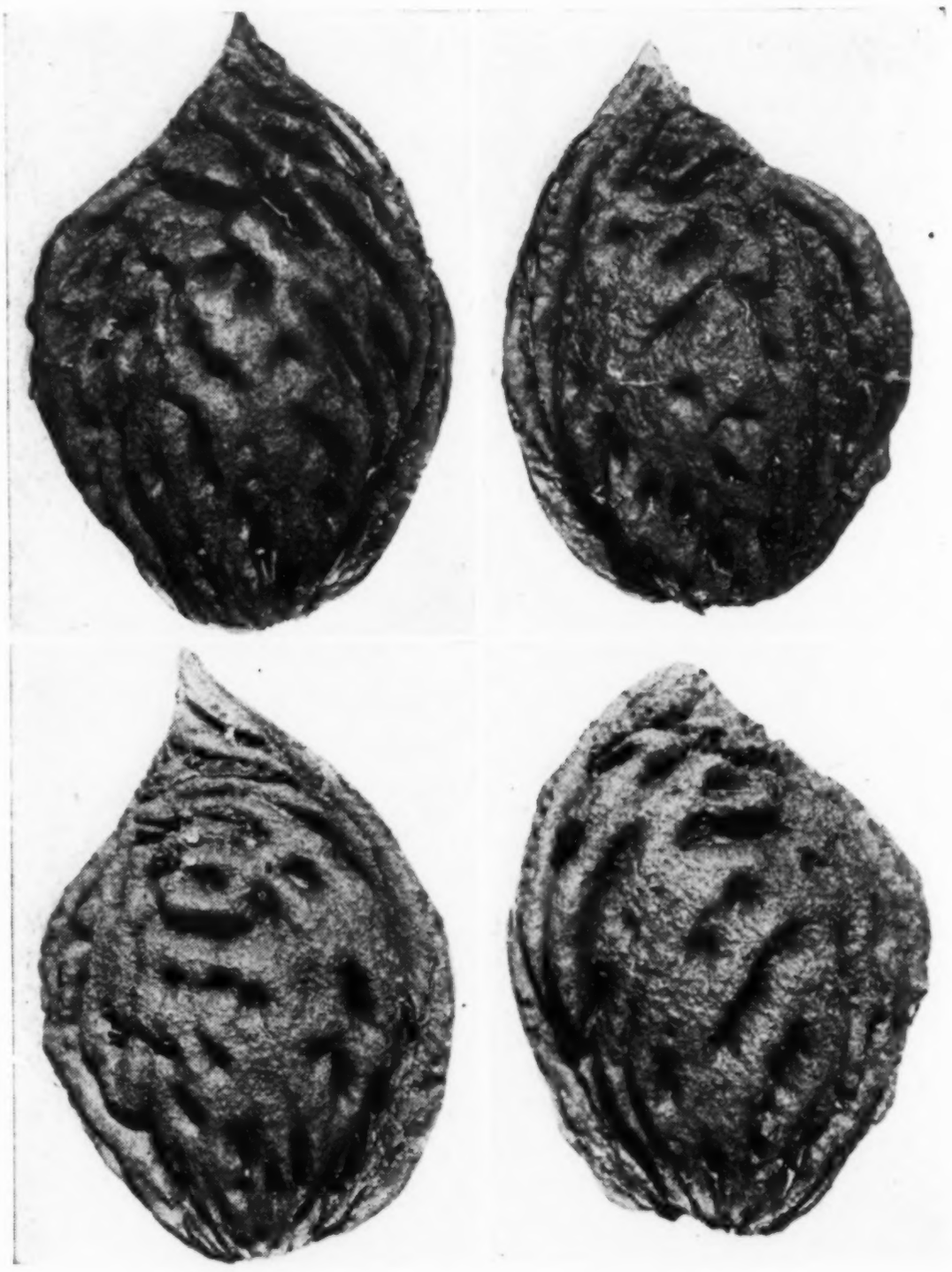
The fruit of Gage above, compared with that of Elberta below. Note the similarity in shape, the nature of the surface, and other characters such as the suture line. Photograph somewhat reduced.

Fruit Similar to Elberta

As noted above, the fruit of Gage resembles Elberta so closely that the two cannot be separated when mixed in a basket. Mr. Gage stated* at one time that the new peach is "a little more pointed at the tip end and a little more fuzzy" than Elberta. This year a careful comparison, character for character, with Elberta showed no con-

*At the winter meeting of the Illinois Horticultural Society, December 14-16, 1927, the Committee of the Society on the revision of the variety list, in conference with Mr. Gage,

stant difference. It would be strange, however, if there were no difference considering the degree of departure of the general characteristics of the tree from Elberta. An idea of the resemblance of the fruit to Elberta may be gained by studying Figures 9, 10, and 11, in which seed, flesh, and fruit can be compared. In selecting the material for the photographs a number of specimens of each variety were available and an attempt was made to choose typical fruits. "There is a little difference in the time of ripening; perhaps" Gage is "two or three days later" than the parent type, but both can be picked at practically the same time. Mr. Gage has found them about equal in hardiness and productiveness year after year. It will be seen, therefore, that with the close resemblance of the fruit to Elberta, notwithstanding the great difference in habit of tree, there is some justification in naming the new variety "Gage Elberta."



SIMILARITY OF SEEDS

Figure 11

Seeds of Elberta (above) and Gage (below). No constant differences have been noted. In spite of the fruit similarities, the varieties differ in form of tree, in foliage characteristics and in resistance to *Bacterium pruni*.

Resistance to Bacterial Infection

Aside from the above tree and fruit characters, Gage is interesting from another standpoint. About 1924 the owner called attention to its relatively high degree of resistance to *Bacterium pruni*. According to Mr. Gage, it has never been badly defoliated and the fruit has always been clean and almost entirely free of serious infection. On the other hand, Elberta and J. H. Hale in his orchard have lost most of their leaves on several occasions—*Bacterium pruni* having been a factor in production in this orchard since 1913.

This characteristic has been a subject of investigation from time to time since 1924, and in 1927 and 1928 a careful comparison was made with Elberta and J. H. Hale. A decided leaf infection was evident in the summer of 1928, and some fruit infection could be found both in 1927 and 1928. However, the fact that neighboring Elberta trees were almost defoliated in 1928 and the fruit of neighboring j. H. Hale trees showed 50 to 60 per cent infection at a time when the fruit

named the new type Gage Elberta since that name had also come to be used among peach growers. According to the rules of nomenclature, however, the name should be Gage. The following are references to the use of the different names. "Dwarf Elberta." *Trans. Ill. Hort. Soc.*, 60:451. 1926. *Trans. Ill. Hort. Soc.*, 61:35. 1927. *Ill Horticulture*, 17:1. 1928. "Gage Elberta." *Ill. Hort. Soc. News Letter.* No. 5. 1. 1928.

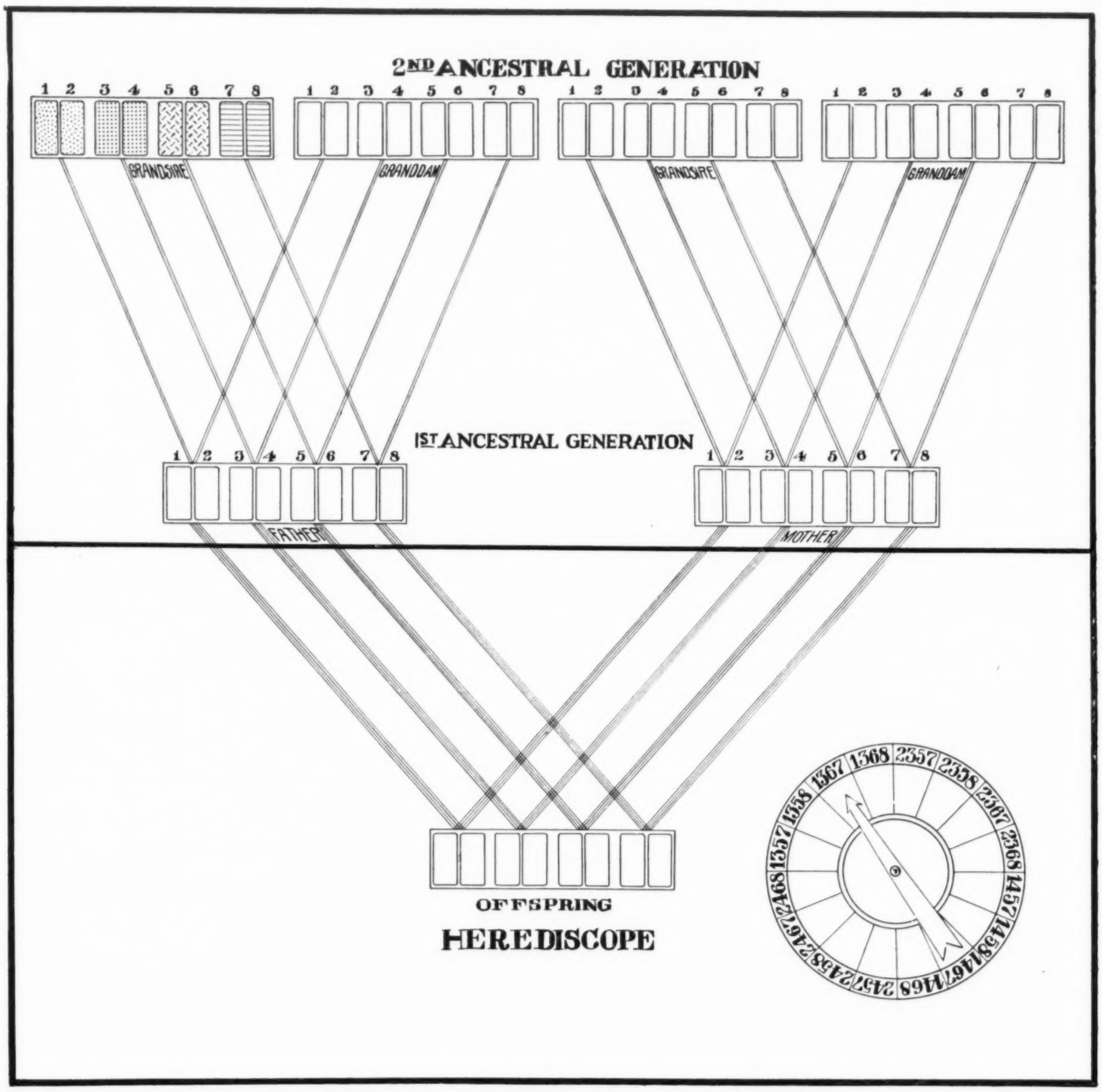
of Gage was remarkably clean, justifies the statement that this new variety possesses a high degree of resistance.

Just before harvest in 1928, when infection was especially severe, a careful study was made of the status of this disease. On a Gage tree surrounded by Elberta 300 peaches were examined, four of which showed moderate infection. A count of 600 fruit on two neighboring Elberta trees gave 110 infected, or 1.3 per cent for Gage as compared with 18.3 per cent for Elberta. In addition to this, fully 50 per cent of the J. H. Hale peaches from this orchard showed infection. The Elberta trees had lost almost all of the older leaves, and the new ones, which pushed out as a result of the defoliation, were light in color, thus showing a sharp contrast to the dark green leaves of Gage which had retained its foliage. It was not found possible to get an accurate comparison of leaf infection with Elberta, but the fact that Gage retained its foliage in spite of the rather heavy infection is significant. The effect of the attack of the bacteria is minimized if the leaf is retained. If the infections of *Bacterium pruni* continue to be as severe as in the past, the high degree of resistance, or tolerance of Gage to this bacteria, may prove to be its most valuable asset.

Origin of the Gage Variety

One question now naturally comes to the fore: What is this new variety? Is it a seedling, or is it a bud sport from Elberta? It appears, from the evidence at hand, that the manner of its origin cannot be answered with certainty. However, the fact that "three to five" trees appeared simultaneously in the orchard suggests strongly the probability that a few bud sticks had been cut from a limb having its origin as a bud variation. Had there been a seedling tree instead of a single limb to cut bud sticks from, more trees of Gage might have been expected to appear in the new plantings. If Elberta is the parent tree, as might be expected under the circumstances, the genetic changes taking place in the bud variation have affected the tree characters more than those of the fruit. In fact, the similarity between the fruit of Gage and Elberta may be considered as one of the strongest points in favor of looking upon bud variation as the method of origin of this variety. The dark green foliage and the high degree of resistance to *Bacterium pruni* indicate a genetic change which has influenced physiological processes as well as more evident external characters.

With fruit so closely resembling Elberta, Gage has, in its habit of growth and resistance to, or tolerance of, *Bacterium pruni,* two additional characteristics which must be reckoned with. It will be evident that greater resistance to infection from *Bacterium pruni* will be welcomed by growers generally. The habit of growth, however, will need to be given special study in order to work out the best cultural methods. It now seems that the planting distance should be increased to about thirty feet and that the number of scaffold limbs should be limited to three or four. The more upright growths from the scaffold limbs are relatively short and naturally fill in the entire top. It may be that Gage can be successfully grown in this way as with the open center if in pruning the top is thinned sufficiently to let in the light. It would seem that this variety would be especially suited to those regions where the peach is inclined to grow too luxuriantly, making heavy cutting necessary in order to keep the bearing surface within bounds.



SCHEME OF THE HEREDISCOPE

Figure 12

Each group of eight "chromosomes" (4 pairs) represents an individual. The contrasting characters are indicated by the shading in the "grandsire" group in the upper left corner. Only one of each pair can be transmitted at each mating, and in each instance which are to be actually chosen is determined by the revolving pointer at the right. This is spun by hand, and where it stops indicates which four characters are transmitted. This is repeated for each of the four grandparents in turn; and for the two parents to obtain the genotype of the offspring.

A SIMPLIFIED HEREDISCOPE

ABOUT a year ago the "Herediscope" invented by R. R. Graves was described in the *Journal,* with pictures of the device and its mechanism. Mr. Graves received many inquiries about the herediscope from all parts of the world, but it was so large and expensive to make that its general adoption for demonstration purposes and in the classroom was out of the question. The few that were made cost about $160.00 each, and unless large quantities could be sold this represented about the minimum cost of manufacture.

There seemed to be a definite need

for a less expensive device of this kind, and Mr. Graves has developed a simplified form of the Herediscope that serves all the purposes of the original, and that can be made for a fraction of the cost. The simplified herediscope resembles a folding checkerboard, with the various factors represented by celluloid "men" of various sizes and colors. The element of chance is brought in by a revolving pointer which is spun with the finger. This indicates which "gene" of each of the four pairs is selected in each trial. The device can be used to demonstrate either the inheritance of four pairs of allelomorphic characters or of multiple factors, up to four pairs. Other applications will undoubtedly be worked out.

The drawing (Figure 12) shows in outline the details of the new herediscope, but a satisfactory model was not completed in time to show in this number. The necessary "genes" and charts for recording results accompany the device. The Herediscope affords such a clear and simple means of demonstrating the elements of Mendelian heredity that the A. G. A. has arranged with Mr. Graves to distribute the device. It is hoped that the herediscope will be a means of enabling the layman and the student to grasp the essentials of Mendelism more readily than by the methods of explanation now in vogue. The new Herediscope will soon be ready for distribution; inquiries should be sent to the office of the American Genetic Association, Victor Building, Washington, D. C. The cost of the Herediscope will probably be $2.50, with a considerable reduction when a number are ordered for use in classes.

It is very desirable that the new Herediscope be given a test in genetics classes this year. For this purpose a limited number of herediscopes will be available for trial by members of the A. G. A. who are in position to use them for this purpose. Application for herediscopes for use in this way should be made as soon as possible, as the requests will be fillled in order of receipt as long as the supply lasts.

CORRESPONDENCE

Grants in Support of Research on the Effects of Radiations upon Organisms

At the suggestion of Dr. W. C. Curtis we are reprinting an announcement which appeared in Science *for January 4.*—EDITOR.

AT the meeting of the Division of Biology and Agriculture of the National Research Council, held in April, 1928, a group of investigators[1] requested approval by this division of an attempt to obtain funds in support of studies on the "Effects of Radiations upon Organisms."

This project was endorsed by the division and a general committee and a sub-committee on solicitation of funds were immediately appointed, and, later, a sub-committee on allotment of grants.[2]

Generous response has been met in the early solicitations and the com-

[1]These individuals were: Edgar Altenburg, H. J. Bagg, A. F. Blakeslee, W. C. Curtis, A. U. Desjardins, C. Stuart Gager, T. H. Goodspeed, Robert T. Hance, F. B. Hanson, E. E. Just, Henry Laurens, C. C. Little, J. W. Mavor, H. J. Muller, Charles Packard, W. J. Robbins, Herman Schneider, George Sperti, L. J. Stadler, Alexander Weinstein, P. H. Whiting.

[2]The personnel of these committees includes: *General Committee,* W. C. Curtis (Chair-

mittee is able to announce that two contributions of $12,500 each have been received from the Commonwealth Fund and from the General Education Board. These contributions will be repeated annually for a period of five years, if satisfactory progress can be made in the support of these investigations. Contributions of other funds have been received from manufacturers and also of apparatus, such as X-ray and ultra-violet equipment, and of the loan of radium, totaling in value about $40,000. It is expected that additional donations will be received. These contributions from manufacturers will be listed in a later announcement by the committee.

As these funds are now available, investigators, who have worked in this field or who have peculiar qualifications for such research, are invited to present requests for support not later than March 1, 1929, for the period ending May 31, 1930. Application blanks may be obtained about February 1.

The general conditions under which grants of money or apparatus will be made were stated as follows in the proposal approved in April, 1928, by the Research Council:

I. To be eligible for consideration, an investigator must present evidence, either in the form of published papers or otherwise, that he has a problem well in hand or he must have obvious qualifications to undertake such research. He must also satisfy the committee that his institution is furnishing reasonable support and equipment for general purposes if not the special features of this work. Time available for the research will be a consideration, particularly in the case of individuals engaged in teaching.

II. The items for which a grant may be expended, which include:

(a) Salaries of research assistants, technicians, clerical assistants, and others who may be employed in the prosecution of any such investigation.

(b) Purchase of materials, instruments, equipment, etc., such as might not be expected in a laboratory with good general equipment.

(c) Any other assistance, exclusive of the investigator's salary, which any project legitimately requires. Under this head a limited amount may be spent for traveling expenses by the investigator.

(d) The investigator's salary will be paid in full by his institution, which will thus contribute by the time the individual is allowed for research as well as by the general facilities of a well-equipped laboratory. In some instances, however, it may be possible to allow men on sabbatical half-pay a balance on salary account, not to exceed $2,500 for a twelve-month period.

It is therefore intended that the institution in which the investigator is working shall do its share. The committee hopes to encourage research in smaller institutions and departments, as well as to support work in the largest and best equipped universities and research institutes.

More explicit statement of policy can not be made at the present time. All communications should be addressed to the Division of Biology and Agriculture, National Research Council, B and 21st Streets, Washington, D. C.

W. C. Curtis, *Chairman,*
General Committee on Radiation.

man), L. L. Woodruff, and D. H. Tennent; *Sub-committee on Solicitation of Funds*, W. C. Curtis (Chairman), C. C. Little, Herman Schneider, William Crocker, and L. L. Woodruff; *Sub-committee on Allotment of Grants*, D. H. Tennent (Chairman), G. H. Parker, H. S. Jennings, C. E. Allen, W. C. Curtis.

Sibolangit Jungle Garden Not Closed

In the Journal of Heredity, Vol. 19. No. 5, I find an interesting article on the garden of Sibolangit. In a note at the end of it I see that you got information that this garden is closed by thhe Dutch Government. It is just the contrary. The plant association has maintained this garden for us during three years and in this year the government has given me the money to

develop it farther. Only Mr. Loerzing, the assistant curator of the garden, has got his pension. It was not possible to keep him there longer, and I hope that the garden in future will remain as interesting as it has been up till now.

We have here another jungle garden, in the mountain garden in Tibodar which covers the slopes of the volcanoes Mount Gedeh and Pangerango from 1400 meters up to 3000 meters; covering an area of about 1200 hectares. There exists a fine description of this jungle by Joseph Rock, in the Hawaiian Planter's Record, Vol. XXII, No. 2, February, 1920.

DOCTOR VAN LEEUWEN,
Director of Agriculture, Buitenzorg, Java.

Dairy-Herd Records Used to Test Cows and Prove Bulls

THE dairy herd improvement association records are a gold mine of useful information. Their purpose is twofold—to test the cows and to prove the sires," says J. C. McDowell, of the Bureau of Dairy Industry, United States Department of Agriculture.

From a study of these records he finds that the cows having an average butter-fat production of 100 pounds a year make an average income over cost of feed of $14; those producing 200 pounds per year return $55 over cost of feed. The next 100 pounds increase in production per cow raises the income over cost of feed to $96; the next to $138; and the next to $178. Briefly stated, as butter-fat production increased from 100 pounds to 500 pounds per cow the income over cost of feed advanced from $14 to $178, or as butter-fat production increased five times the income over cost of feed increased thirteen times. Evidently it pays to keep good cows.

"All dairy-herd improvement," he says, "must come through culling, feeding, and breeding. Through the dairy herd improvement association records the dairyman is enabled to cull out his low producers, to feed the remainder according to known production, and to breed intelligently.

"When the production records of from 5 to 10 unselected daughters of a sire are compared with the production records of their dams, the breeding value of the sire is indicated. If his daughters' records are unsatisfactory, the sire is condemned. A dairy cow is condemned by her own record.

"So far, the association records have proved about 600 dairy bulls. Of these, only one-third brought big gains in the herds in which they were used and one-third actually lowered the production average of their herds. Only one bull in six was alive at the time he was proved. Some way should be found by which all well-bred dairy bulls can be kept alive until the records of their daughters prove their value. Then by means of a cooperative bull association or similar organization all meritorious proved bulls should be kept in extensive use as long as they live or are fit for service.

"The proving of meritorious dairy sires in large numbers is one of the great problems before our dairymen today. When farmers have the proper appreciation of the value of the proved bull, we shall be able to prove hundreds of dariy sires each year in our association work. Judging from the results obtained from the bulls already proved, one-third of the bulls proved in the future will be highly meritorious. From the extensive use of these bulls our dairy herds will improve rapidly, and average production of milk and butter-fat per cow will reach higher levels than ever before."

WHOSE BABY?

PAUL POPENOE

Pasadena, California

THERE was a splash in the Landwehr canal, a shout from a passer-by; Berlin police jumped into the water, unmindful of their neatly pressed uniforms, pulled out a struggling young woman, pushed back the crowd which collected, and took their charge to a hospital, where the entry, under date of February 17, 1920, was "attempted suicide".

There were no marks of identity on the girl, and she kept silence. After two months she was committed to the Daldorf Asylum, where she obviously belonged, and where she was listed as "Fraulein Unknown". Her aristocratic bearing excited attention; her complete reserve balked it. Only after two years did she talk to a sympathetic nurse, and then she unfolded a story that might have made the Man in the Iron Mask jealous.

She was, she said, the Grand Duchess Anastasia Nicholaevna, daughter of the late Czar Nicholas II. of Russia. When the imperial family was wiped out in the midnight massacre at Ekaterinburg on July 17, 1918, she was taken away for dead, with the others. Being only wounded and stunned, however, she was saved by a young Red soldier, who finally escaped with her to Rumania, where they lived for nearly two years, and where she bore him a child. After his death she made her way to Berlin, hoping to meet kinfolk and be recognized; but in despondency at her prospects she had attempted to die in the canal.

It was not until 1925 that the invalid's case received further attention—for strange stories are no novelty in a hospital for mental diseases. Then her cause was championed by several people in Berlin, who interested relatives of the Romanoffs, including the royal family ot Denmark. The claims of the young woman impressed investigators enough so that she was removed to a hospital in Berlin, and supported for more than a year by the Danish court. Then they withdrew their support, asking the Duke of Leuchtenberg, a distant relative of the Russian monarchs, to give her shelter.

Repudiated by Family

Meanwhile, she was visited by many who had known the Grand Duchess Anastasia in her girlhood. Some identified her, some were doubtful, some denied the identity. The question became involved in the political intrigue which flourished among the exiles from Petrograd. In 1927 the Grand Duke Cyril held an "official" investigation, and reported that the invalid was a Polish German peasant girl suffering from a diseased mind.

Others, presumably impartial, declared this was an absurd political invention, and that there was not the slightest doubt that the fretful young matron secluded in the obscure Bavarian Castle Secon was in fact heiress to the throne of all the Russias. They pointed not only to the political implications, but to $40,000,000 of Romanoff money supposed to be in London bank vaults awaiting an accredited claimant, as sufficient reason why many members of the family would not care to have a direct heiress appear.

What was the truth?

It is not creditable to civilization that a question of such interest should still be settled by the method of one of Bret Harte's heroines, who, after relating her story to a passing stranger, ended:

"Folks around here say the old man's my father.

"What's your opinion?"

If the footprints of the little Romanoffs had been taken at birth, and the formulae registered in central bureaus, 10 minutes would have sufficed to establish the identity, beyond a doubt, of the unwilling girl who was pulled out of the Landwehr canal. Any reader will call to mind numerous instances similar to this, in which the history of the world might have been changed by the application of scientific methods—which are now, of course, available as they were not in the past. It has been the rule, rather than the exception, that pretenders should arise when a famous person disappeared; and the self-styled Anastasia herself has a rival in a young man discovered in Bydgoszcz, Pomerania, Poland, who calls himself Eugene Mikhailovitch Ivanov, and is asserted actually to be the czarevitch Alexis, whom he resembles even to having hemophilia. The story is that he escaped the slaughter because the cook's son was substituted for him.

Other Historic Cases

Perkin Warbeck (1474-1499) claimed the throne of England, and found many who believed in his pretension to be Richard Duke of York, supposedly murdered in the Tower in 1483 along with the Prince of Wales (the so-called Edward V.) In later times, even such a man of the world as Horace Walpole gave credence to the claim, although the impostor was captured and hanged by Henry VII.

Sebastian, king of Portugal (born 1554) disappeared during a battle in Morocco in 1578. Several impostors arose, of whom one, "The Knight of the Cross", appearing in Venice in 1598, had the Habsburg lip and fifteen other physical marks which, he declared, proved his identity. He was hanged in 1603.

Contests for property have often turned on this point, one of the most famous being the Tichborne case in England, still within the memory of older readers. Although it was at its height half a century ago, the claimant (Arthur Orton, a butcher's son) died only in 1898. Over 100 persons who had known the heir intimately (including his own mother!) swore to his identity. One of the oldest baronetcies in England was involved, and it is said to have cost the estate $500,000 to defend itself against Orton's claims; with proper registration of the facts at the birth of the heir it would not have cost $5.

But the most interesting, in some ways, of the historical cases is that of the dauphin of France, so-called Louis XVII. This child was born on March 27, 1785. After the execution of his parents, Louis XVI and Marie Antoinette, he was retained as a prisoner in the Temple (a former fortress of the Knights Templar) in Paris, where he was badly treated, and where he was reported to have died of scrofula and neglect on June 8, 1795. It was given out that he was buried in the cemetery of Ste. Marguerite, two or three days later.

An American Prospect

There was enough uncertainty about these facts, however, and enough to be gained by denying them, to give rise to a whole crop of putative dauphins, numbering at least thirty altogether, during the next half century. Indeed, the child had as many reincarnations as has "the long-lost Charley Ross." Even America produced a claimant to the throne of France: not "the late dolphin" whom Huckleberry Finn encountered on the lower Mississippi, but a pious Congregational missionary to the Indians (who afterward showed the perfidy expected of royal families by backsliding to Episcopalianism), Rev. Eleazer Williams.

The story is that in 1795 a small party of French people, including a woman who said she had been maid of honor to Marie Antoinette, and who showed a number of trinkets to substantiate the claim, appeared at Albany, N. Y., with a ten-year-old boy whom

they treated with great respect and always spoke of as Monsieur Louis. They disappeared shortly, but a few months later two Frenchmen came to a settlement of the Iroquois Indians and left the same boy in charge of the chief. He was brought up as were the other Indian children; but it was declared that several years afterward two other mysterious Frenchmen came to the settlement, kneeled before the boy, and treated him with all the honors due to royalty.

He was later sent to school and trained as a missionary, and in adult life asserted his supposed identity, but never made any attempt to recover the throne of his supposititious ancestors.

More aggressive was Karl-Wilhelm Naundorf, who remains the chief pretender to the dauphinate, and who succeeded in deceiving many intelligent persons, and perhaps even deceived himself in the end.

This man, born at Potsdam of a Jewish family from Poland, was a clockmaker by trade, and at one time spent three years in prison for counterfeiting. He studied assiduously all the details obtainable concerning the royal family, and when he threw his hat into the ring he had made himself as nearly letter-perfect as any one could. He came to Paris and immediately won a following, being "recognized" by Mme. de Rambaud, former governess of the real dauphin, and others who knew the Bourbons. Money began to flow to him to establish his pretensions; the French government finally deported him to England, where he lived for several years by the manufacture of fireworks for sale and the practice of spiritualism. Then he removed to Delft, Holland, where he established his court and resided until his death. His tombstone, no more mendacious than many other such monuments, bears witness: "Here lies Louis XVII, King of France."

His son, and later his nephew, succeeded him as "heir apparent", and a great-nephew was maintaining the position there in 1904, when Augustin Cabanès visited him. He was a good specimen of the numerous relicts of near-royalty that exist all over Europe, living on hopes and dupes in a style to which only Tom Sawyer could do justice. Callers were not admitted unless they agreed to address him as "Monseigneur"; but, says Dr. Cabanès, "I was quite surprised—almost disappointed, to find myself facing a man of very vulgar appearance and almost trivial language." What did he expect to find?

As late as 1928 a middle-aged blind man, Prince Louis de Bourbon (*sic*), appeared in Paris and won front-page space, next to almost pure reading matter, by reviving the claim of his ancestor Naundorf. His talking-point was that the opening of governmental archives in several countries, following the World War, had enabled him to get access to correspondence of the Duchesse d'Angoulême, the Duc d'Orleans, and the Duc d'Enghein, which established clearly the legitimacy of the Naundorf pretensions.

Habsburg Characteristics

The French royal family had sharply defined peculiarities, in common with other Habsburgs, which gave much aid to anyone attempting to prove or disprove a claim to kinship. The only surviving direct descendant was the Duchesse d'Angoulême, sister of the dauphin. She was living at Prag, and Naundorf made many vain efforts to enlist her sympathy. She had the striking face of her mother—a high skull, long chin, and perfectly rounded but protruding lower jaw. The four incisors of her upper jaw, instead of making an arc, formed a straight line.

Moreover, the infant dauphin had a number of peculiarities, described by Mme. de Rambaud and others who had ample opportunity to know. He had the same mouth as the queen, a little dimple on the chin, deformation of the incisors of the lower jaw, the tra-

ditional "strawberry mark" on his right breast, and on his thigh "the sign of the Holy Ghost, formed by small veins and representing a pigeon with its wings outspread and head lowered, a mark which of all others could not be imitated."

There was, then, a good deal of material to work on, had it been used by a competent and impartial clinic. But, as I noted above, even Mme. Rambaud herself acknowledged Naundorf, in spite of the fact that he had virtually none of these peculiarities. He gave out that his eldest daughter, Amèlie, had them; but V. Galippe, who examined the portraits of all his children (they rejoiced in such names as Charles XI, Marie-Antoinette, Adelbert de Bourbon, and Marie-Therèse) says that none of them had any Habsburg characteristics; nor did their children in turn. Yet there are still people in France who are firmly convinced that Naundorf was the dauphin.

An obvious line of investigation was to exhume the body of the real dauphin, and this was first attempted in 1816 at the instigation of René de Chateaubriand, the famous novelist and active royalist, but the remains could not be found. In 1846 another attempt was made, and a skeleton was dug up which was declared to be that of Louis XVII. The report of several physicians did not bear this out—they said it was that of a boy 15 or 20 years old.

Almost half a century later the question was taken up again and further researches made. A lead coffin was encountered which bore the legend "L. XVII" and which contained a skeleton that was thought to be the one discovered in 1846 (at which time it is supposed the lead coffin was provided). Examination was made by L. Manouvrier and other competent anthropologists, who agreed that it was a youth of 18 or 20 years and hence could not be the dauphin. The lower jaw protruded, however, and had it happened to be that of a 10-year-old child, few would have doubted that it was the skeleton sought. As it is, the remains in question have never been found.

Akhnaton's Mummy

Anthropological evidence of this sort may be good enough to identify a mummy as that of Akhnaton was identified. This pharaoh came of a highly inbred family[1], and from such traits as the shape of the face, especially the chin, and the teeth, in which he resembled his father and grandfather, it was possible to be reasonably certain of his remains. But it is almost incredible that parents occupying such a conspicuous position as a royal family, or indeed any intelligent parents who are devoted to their children, should not take the slight precautions necessary to furnish these children with proof of identity. As it is, probably the truth about the putative Anastasia (who goes under the name of Fraulein von Tchaikovsky, and who came to the United States in 1928) will never be known beyond the possibility of doubt.

While it is impossible for the student of heredity to say that a given man is the father of a given child, it is not difficult, in some cases, for him to prove either that a designated man might have been, or else that he could not have been, the father of a given child.[2]

This involves examination of the resemblances and differences between parent and offspring. One must make use of traits that are (a) sharply defined, (b) little affected by outside influences, (c) not subject to falsification, and (d), in most instances, determinable early in life. It is a mistake to depend on any one criterion, as some courts lately have depended on the test of blood groups. Approach to certainty is to be had in proportion to the number of traits studied and to the number of generations of ancestry investigated.

The blood-group test[3] is, however,

such a simple and useful one* that it has been applied in thousands of cases during the last decade—some of them cases that had been settled years previously, but were reopened at the request of a man who declared paternity had been adjudged to him wrongly and asserted that the new tests would prove his innocence.

In one case, identification marks were lost on two newborn babies, and neither family could claim its own. Examination showed the blood grouping to be:

Jones Family	Smith Family
Father I	Father I
Mother I	Mother II
Child I	Child II

Child I could belong to either family, but since child II could belong only to the Smiths, child I must belong to the Joneses.[5]

The test of blood grouping, like any other test, will of course not tell who was the father of a given child; it will show either that he might have been, or that he could not possibly have been†: Its greatest value is therefore negative, so to speak. But, under any circumstances, every unmarried mother should have her blood group recorded at the birth of her child, to aid in establishing the child's paternity in case the question should arise at any time in the future.

Crucial Traits

In general, the same sort of traits are useful in establishing paternity that are used in determining whether twins come from one egg or two.[6] The alternative inheritance of many abnormalities will occasionally play a part. The remote, as well as the immediate possible ancestry should be studied. Eye color is easy to see, but not definitely fixed in the infant during the early months of life. The direction of the whorl of hair on the occiput, the distribution of the downy hair on the body; the blood groups, the prints of the sole of the foot, of the palm, and of the fingers, microscopic comparison of the capillaries, the form of the ear, X-ray photographs of the skull, together with the more commonly noted traits will often, if properly used, give results with a high degree of accuracy.

Not many cases are as extreme, and therefore as simple, as one in which the alleged father of a child had short joints of certain fingers and toes (brachyphalangy). The hands and feet of the child showed exactly the same malformation and X-ray photographs indicated absolute correspondence of the bones in the case of this dominant trait. The man was therefore declared unhesitatingly to be the father.[7]

Such studies should not be left to self-styled experts, in the pay respectively of prosecution and defense, and engaged for mutual contradiction as has been too often the case in insanity hearings. A competent clinic should be designated by the court, and its findings made official.[8]

Lawyers hold that the defendant can not possibly be denied the right to introduce his own experts. However, if, instead of being put on the witness stand for the psychological farce of direct- and cross-examination, the de-

*After I had written the review which appeared in the October, 1928, issue of the JOURNAL OF HEREDITY, K. H. Bauer of Göttingen published a paper in which he brought forward a good deal of evidence to show that the inheritance of the blood groups in man can be explained best by supposing that it is due to two independent pairs of allelomorphs, with crossing over between them. If this conclusion is confirmed, it will represent the first case of crossing over established in man.[4]

†There is a legend related by the youthful Roman poet M. Annaeus Lucanus in his *Pharsalia* (A. D. 67) of the Psylli, a tribe living in what is now Libia. Through long exposure, they were said to have become immune to the bite of the asp, and in case of doubt as to the paternity of a child, it was inoculated with the venom of this snake. If it was a true Psyllus, it would be unharmed, whereas if its blood contained an adulterous intermixture from some other tribe, death would ensue. What was the real basis, if any, of this fable?

NO DOUBT ABOUT WHO OWNS THIS BABY

Figure 13

If the infant's footprint is taken at birth and his mother's fingerprints taken at the same time on the same card, here can never in the future be any possibility of mistake about the maternity. The fat little foot is not easily printed, but with some care a good impression can be got, which can be read easily with a hand lens. The large creases shown above in the sole of the foot help to identify the infant during the first few months of life, but they then disappear except in special cases, such as that of the so-called Mongolian idiot. The friction-skin pattern is permanent and unalterable. Prints from the Pasadena Hospital: above, infant; below, mother; natural size.

fendant's experts were allowed to consult with the official clinic, the truth would probably be reached in most cases without sacrifice of any one's interests.

All these formalities would be avoidable in most cases, if a print of the pattern of the sole of the foot of the new-born babe were taken (the fingerprints of a tiny baby are difficult to get); and for their own protection, parents should insist that this be done. One never knows when absolute proof of identity may be of overwhelming importance; even the possibility of exchange of an infant is by no means unthinkable. While this paper was being written, newspapers carried a story that, though unusual, illustrates the point. In a reputable hospital,

three babies named Brown were born on the same day. Mrs. Sam Brown was told that hers was a boy, and loved it as such, but after a week, being left alone to nurse her offspring, she undressed it and found evidence that it was a girl. The father thereupon brought suit against the hospital, calling for restoration of his son and heir. The interne and nurse who had delivered the baby and announced it as a boy then declared that they must have been mistaken on this point. The ward nurse, who had bathed it three times, said she really had not noticed whether it was a boy or a girl. Sam Brown and his wife may go through life with a shadow of doubt always in their minds as to whether the little girl is theirs or not. Anyone else might conceivably have the same experience. When a tray of six or eight babies is pushed down the hospital corridor, each one calling earnestly for nourishment, few parents can identify their own positively. The moral is to make use of the resources of science.

Birth Registration

In the last analysis, it is true, the paternity must be settled by what might be called indirect evidence, since the child can not be seen physically tied to the father at any time, as it can be seen tied to the mother at birth. For this reason, even with the most complete system of birth registration, there will always be need for application of a knowledge of heredity and other circumstantial evidence.

With the maternity this need should never arise, for it is ideally possible to register the baby's identity before the navel cord is cut, and if the mother's identity is registered at the same time on the same card, the problem is settled even beyond the skepticism of a professor (who, according to the German jibe, is "a man who is of a different opinion.")

As sole prints are usually taken, they are smudged so that merely the creases of the foot show, and these change repeatedly in later life. Any bright nurse, however, can become an expert and take the infant's sole print successfully by not using too much ink and not using too much pressure. A piece of glass should be coated with a thin film of ink, by the aid of a rubber roller such as photographers use; then the infant's foot put lightly on it and equally lightly placed on the registration card.. The mother's fingerprints, or even a single one—the right index is usual—should be registered alongside, and the problem is settled for all time.* The customary string of lettered beads, or numbered strip of adhesive plaster, may be used with this for convenience, but there is no substitute.

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MULTIPLE KERNELS IN WHEAT-RYE HYBRIDS

Double and Triple Kernels in Florets of Rye and Wheat × Rye Crosses

R. P. Bledsoe

Georgia Experiment Station

ONE of the most stable characteristics of the Grass Family is the production of one kernel per floret. The ovary of all species of grasses is unilocular, and while the pistil is generally assumed to be one-carpelled there are indications that it is composed of three carpels. Walker,[1] after studying a number of species of grasses, concludes that two carpels form the bulk of the ovary and bear the style branches while the third carpel, usually reduced to a narrow structure extending only to the top of the ovary, contains the bundle which bears the ovule. This arrangement is especially evident in genera having three styles, and in others, including maize, it is shown by the vascular system. The evolutionary changes involved have never been investigated, but the tricarpellary condition may be the connecting link between grasses and other monocotyledonous plants.

Leighty and Sando[2] describe and illustrate certain abnormalities in wheat flowers which they call "Pistillody." In a variety of wheat from Argentina they found the stamens metamorphosed either wholly or partly into carpels. None of these extra carpels produced seed, but in some cases the shrivelled ovaries of the extra carpels were found attached to a mature kernal.

As these abnormalities did not appear in the next generation, Leighty and Sando concluded that the variation was not inheritable, but was caused by growing the plants under greenhouse conditions. Leighty and Sando also observed modified anthers in two other varieties of wheat. Anthony[3] describes another case in wheat where anthers are modified partly into stigmas. He thought the variation was caused by growing the wheat in the greenhouse. He does not appear to have grown the second generation. Leighty and Sando also describe a similar variation found by Mr. J. W. Taylor in three wheat × rye crosses grown in the greenhouse at Arlington Experimental Farm.

In 1923, the writer grew two F_2 wheat × rye hybrids in the greenhouse which showed a condition practically similar to that described by Leighty and Sando in the wheat from Argentina. As these hybrids were entirely sterile it was not possible to determine whether or not the variation was inherited.

Double and Triple Kernels in Rye

In 1925, while harvesting some Georgia rye which had been selfed in the open since 1921, three plants were found growing in plat P24-1-1-3 which contained florets with two or three kernels per floret (Figs. 15, 16 and 17). Only a few heads on a plant and only a few florets in a head showed this character. These kernels were slightly smaller than the aveage rye kernel and slightly flattened on one or two sides where pressed against neighboring kernels. Otherwise the kernels appeared to be normal. The progeny of these three plants produced double and triple kernels in 1926, 1927 and 1928. Also double and triple kernels have been found in the progeny

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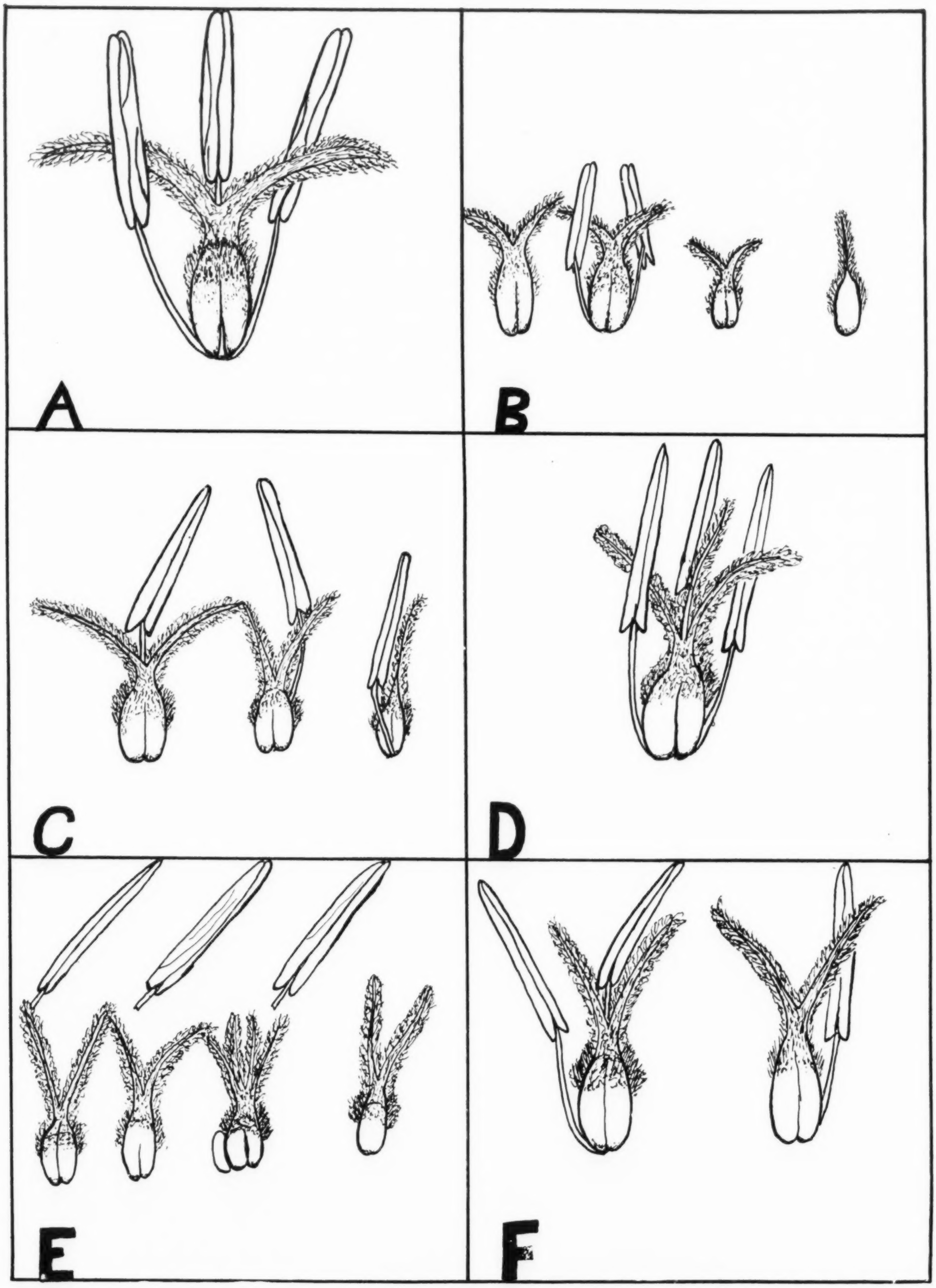


NORMAL AND ABNORMAL RYE FLOWERS

Figure 14

A: Reproductive organs of a normal rye flower. B: Flower with four carpels and two stamens. One carpel has only a single stigma. C: Flower with three carpels and three stamens. D: Carpel with three stigmas. E: Flower with five carpels and three stamens. One carpel is small and firmly attached to another carpel. F: Flower with two carpels and three stamens.

A SPIKE OF RYE SHOWING DOUBLE KERNELS

Figure 15

Both the third and eighth nodes have produced two sets of double kernels, while the tenth and fifteenth nodes have produced one set each.

of 13 other plants from P24-1-1-3. So far, only rye plants from line P24-1-1-3 have shown the variation although a number of other lines of P24 have been selfed and have been carefully examined.

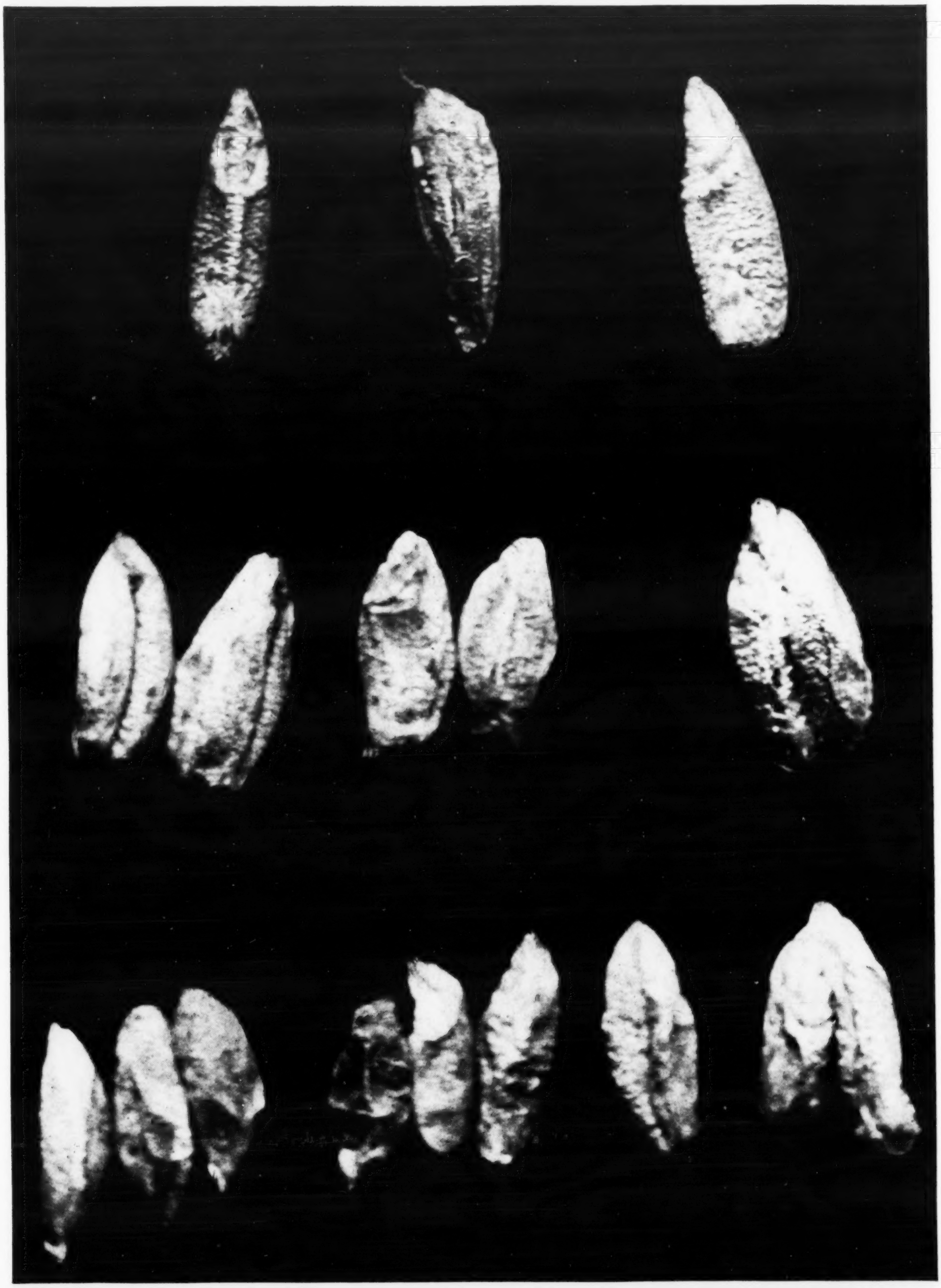
The seed from florets producing double and triple kernels appear to be normal in every respect except their slightly smaller size. A number have been germinated and plants raised from the seed. Thus far all these plants have shown the variation.

To see if bagging the heads had anything to do with causing the variation, a number of plants, both in 1926 and 1927, were not bagged. A number of double and triple kernels were obtained from the unbagged plants. It appears from this that the variation is not caused artificially.

An examination of flowers of plants having double and triple kernels showed a condition very similar to that described by Leighty and Sando in the wheat from Argentina, that is, the stamens in a number of the flowers were transformed into carpels or into structures which were partly stamens and partly carpels. In addition, there appeared to be another variation not mentioned by Leighty and Sando. In some of the flowers the three stamens were either normal, partly modified or entirely transformed into carpels and furthermore, there were two, three, four and occasionally five carpels (Fig. 14). In other words, in addition to the modification of flower parts described by Leighty and Sando, these plants showed a multiplication of flower parts.

In some of the flowers the pistil has three stigmas. This condition is fairly common and often present where there are two or more carpels. This is interesting in connection with Walker's theory that grasses are tricarpellary.

At flowering time a head was selected showing the variation and all the flowers were examined. Twenty-one



KERNELS FROM SELFED RYE P 24-1-1-3

Figure 16

Top row: Three normal rye kernels. *Center row*: Three pairs of double kernels, each pair being from a single floret. Notice that the pair to the right is stuck together due to the crowded position of the seed. *Bottom row*: Three sets of triple kernels, each set from a single floret. The double and triple kernels are only slightly smaller than the normal kernels.

SEGMENTS OF TWO RYE SPIKES SHOWING TRIPLE KERNELS

Figure 17

On the spike to the left one set of triple kernels can be seen, and on the right there are two sets of triple kernels close together.

flowers were normal, while 52 were abnormal. Fifty had two or more ovaries but it is exceptional for a head to have as many as 10 flowers that produce double seed, evidencing that a great many of the extra ovaries are abortive.

At present several lines appear to be homozygous for this variation.

Double Kernels in a Wheat x Rye Hybrid

In threshing out some F_3 wheat $\times$ rye hybrids in 1927 a double kernel was found in one floret of H148-1-5-80. These kernels were smaller than normal kernels and flattened on one side. Like the normal wheat $\times$ rye kernels they looked like wheat rather than rye.

The F_1 wheat $\times$ rye hybrid from which the plant that produced this double kernel came, was found in some wheat plats in 1925. In 1924 this wheat had been grown near some varieties of rye. The variety from which P24 was selected was not grown that year. Also the selfed ryes were grown on another part of the farm, more than 800 feet away from the crossed wheat. The prevailing wind was against carrying the selfed rye pollen to the wheat. Also most of the selfed rye was bagged so that only a small percentage of its pollen could escape into the open air. It is probable, therefore, that the rye pollen in the wheat $\times$ rye cross came from the varieties planted in the same field with the wheat parent and not from the selfed rye.

An examination of the flowers of some of these wheat $\times$ rye crosses showed a condition very similar to that found in the selfed rye. Pistillody was fairly abundant. Several

flowers were found with two or three carpels. None have been found as yet with more than three carpels.

In 1928, in the progeny of H148-1-5-80, were found four sets of double kernels. No double kernels or double carpels were found in any other wheat × rye strains, although a large number were examined. It is evident that this is also an inherited character.*

Discussion

The variations described are evidently inherited and not caused by abnormal growing conditions. All the plants described were grown in the open under what might be described as average experimental conditions. Leighty and Sando describe a condition very similar to that given here which they thought was caused by greenhouse conditions and not inherited. Either this was a mistake or the variations were different from those herein described.

A plausible explanation of this variation is that it was due to a mutation occurring in the rye, later carried over to the wheat by a rye cross. A question then arises as to the cause of the mutation in the rye. Hybridization is known to be the cause of many so-called mutations. Several cases in fact are given of a similar variation in wheat × rye crosses. It is possible that the double kernels in rye were caused by a natural hybridization of rye with wheat or with a wheat × rye cross, and that the second variation in the wheat × rye crosses was also caused by hybridization.

The phylogeny of grasses is as yet little understood. Usually grasses are considered to have come from lily-like plants by a modification and reduction of the number of parts of the flower. Possibly a careful study of the variation discussed here, in which the normal number of flower parts is increased, may throw some light on the question.

Literature Cited

1. Walker, E. R. On the structure of the pistils of some grasses. *Univ. of Nebr. Studies* 1:203-218.

2. Leighty, C. E. and W. J. Sando. Pistillody in wheat flowers. *Jour. of Heredity* XV:263-268. 1924.

3. Anthony, S. An anomaly of wheat anthers. *Jour. of Heredity* IX:166-168.

*Dr. H. V. Harlan, U. S. Department of Agriculture, in a recent letter to the author, states that "double kernels in barley are quite common and triple ones are not uncommon. These occur from a double or triple ovary."

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